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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

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Another Reason for High Taxes

A BLIZZARD last week in the East should have shown a number of complaining citizens one of the reasons why the cost of government is going up. Many a man was awakened in the as yet dark morning by the rumble of a huge motor plow pushing a passageway through the snow clogged streets and later in the day the omnipresent street scene spectators found an absorbing spectacle in the novel scrapers and loaders which rapidly cleared the encumbered pavements. Snow clearing is a necessary part of modern city operation and its necessity is rapidly extending to the country roads. The modern machines do the work much cheaper than the man and shovel but they have more to do, and the costs mount. The taxpayer, the next time he wonders what he is getting for his ever increasing tax bill, may well recall one of these blizzardy mornings.

Constructive Interest

LAST week the Colorado River control plan was discussed at a conference of important financial and industrial leaders in New York City. The discussion was significant because the fact that it was held expressed clearly the national character of the questions at issue. The Colorado is the most important problem of the West, but it is a national problem, not one of the West alone. Its proper solution depends as much on the attitude of the East as on that of the West; indeed, more so, since sound action on any particular problem depends largely on the broader perspective of those who are beyond the range of narrow self-interest. Though the Colorado River lies beyond the Rockies, the influence of those sections of the country that are distant from its course is bound to play a large part in working out the result. The New York discussion, therefore, is a distinct contribution to progress on the Colorado. Similar discussions elsewhere in the East would further promote the development of well informed opinion, as the basis for a sound legislative solution of the problem.

Helping Relieve Traffic Congestion

IN WASHINGTON, on March 23 to 26, there will be held the second national conference on street and highway safety. This conference called first in 1924 by Secretary Hoover has already accomplished much good as a publicity agent. Its first findings have been reprinted many times and numerous local organizations looking toward the bettering of traffic conditions have been activated by the resulting publicity. But the problem of traffic is too great to be solved by one meeting however wide be its ramifications. So this second meeting is called, to be followed probably by more in the future in continuation of the loosely knit organization that has been set up. The meeting next month has been preceded by much intensive committee work, which has covered much more than the question of safety to which the conference's name seems to restrict it. The broader questions of motor laws, uniform traffic regulations and above all city traffic congestion, its cause and its cure, have been debated by experts for nearly a year. The reports of these committees are meaty; they should have the attention of the whole country, throttled and curbed as it is by the growing problem of traffic. By invitation of the President every state will have delegates at the conference but every city should also have one to take home the high spots of the discussion but more than that to be better prepared for the organization of co-operative measures to fight the traffic congestion evil.

Foreign Interchange Professorship

FOR some years seven of the leading eastern engineering schools have interchanged professors with the technical schools of France. It has been an excellent thing for the students and for the professors of both countries. This year it appears that the French appropriation of twenty thousand francs is so depreciated by the unfavorable exchange that the French professor can make only a short visit to this country instead of the three or four weeks that he should spend at each of the seven colleges, though the American professor is enabled to make his usual long trip to France by the joint appropriation of the American schools. The American Society of Mechanical Engineers, through Calvin W. Rice, its secretary, at New York, is making an effort therefore to raise a fund of $5,000 which can be diverted to this useful purpose until such time as French university finances permit a return to the regular co-operative budget. This is a worth-while cause which should appeal to friends of technical education.

A Necessary Commodity

GEOGRAPHICALLY only a small part of the United States uses anthracite coal, but numerically about half the people are now keeping warm with some unfamiliar fuel, instead of the anthracite to which they are accustomed. Not only are they experiencing the difficulties of experimenting with this unfamiliar fuel in furnaces not fitted for its use but they are also paying about twice as much for it as it cost before the anthracite strike, which is from 50 to 75 per cent more than anthracite cost last summer. Discomfort from the strike may so far lie only in the difficulties of getting and using substitutes and resentment only be against the high prices due to profiteering or merely scarcity demand depending upon whether one is buying or selling fuel. The fact remains that the strike is getting on the nerves of the public. Clamor in Congress, however political may be its outward aspect, is evidence

of this. And if and when the strike is settled with the net result of higher prices to the user this clamor will surely bring to a head some legislative action which will prevent a recurrence of the present trouble. Coal is so obviously a public necessity that the public must have some control over its production. It may be that the experience of the past winter will lead the anthracite user to increased demand for the substitutes, in which case the anthracite people will have effected their own destruction, but that possibility is remote. The demand for anthracite will probably continue. The time should be past when either the owner or worker can be permitted to stop its normal flow.

Road Relocation

HIGHWAY relocation as it is carried out in Pennsylvania is notably well described in this issue in the article by W. W. Crosby, locating engineer. A specific example of relocation procedure was selected from Colonel Crosby's paper rather than his discussion of general principles. This it is believed gives the technique better than a more inclusive generalization. And this technique is worth particular notice. In relocating a fraction of route, consideration is had of full route location or possible future relocation. Following this observe the function performed by traffic survey records. It goes far toward justifying traffic surveys even if they served no other purpose. Finally take account of the survey made of the change of line; it takes on the dimensions of economic research. Indeed there is deep engineering in highway relocation as it is conducted in its best manner today. The public which regards it as merely "taking out the kinks" has small understanding as its excuse, but the road official who has no better realization of the function and the problem of relocation is blind to the deepest fundamental of his business—that economic road operation is the ultimate object of road improvement. Still there is far to go before we arrive at a scientific basis for relocating public roads. Colonel Crosby points out that more data need to be accumulated and more general agreement on a logical basis arrived at on the economic effects of lengths, grades, widths, and traffic speeds.

A Tranquil Waterway

LEISURELY construction, as American engineering works commonly proceed, is exalted in the building of the Illinois waterway from Lockport, the end of the present Chicago Drainage Canal, to La Salle on the Illinois River. It was 18 years ago that the people of Illinois voted a bond issue for this new navigation channel. The first enabling act was passed in 1915 and came to nothing because of objections by the U. S. Army Engineer Corps. In 1919 a modified act was passed and received federal approval. It is only since then, of course, that actual construction has been possible. The project calls for five locks and dams in the Des Plaines and Illinois Rivers, river canalization and some connecting and by-pass canal work. One lock at Marseilles has been completed. The second lock at Lockport is under construction as described in this issue. At the present time bids are in hand for the dam and lock at Starved Rock and for the retaining walls of the Joliet pool. In such manner the Illinois waterway is progressing. For this slow-moving policy various reasons—political, financial, jurisdictional and others—are accountable. It is the engineering and construction which merit comment. There are few waterway structures which have been more studiously designed than the locks, dams and power development of the Illinois waterway. There has been unusual design as, for instance, the lift gates of the Lockport lock described in this issue. The construction work has been of equally high character. There has been leisure for perfection in design and care in construction. Illinois is being assured a waterway of excellent engineering design and construction as compensation for the tardiness of progress which other restrictions are imposing.

State Owned Power Again

GOVERNMENT ownership of waterpower and the development of the electrical energy therefrom is coming to be a real issue. For some years this has been a popular thing to talk about, to be advocated mostly by those whose other tendencies in public questions have characterized them as radical, and to be opposed by the more conservative of economists and especially by the public utility interests. Government ownership of power was classed generally with government ownership of everything else, and therefore not to be considered as a serious prospect by the majority of the American people who, so far at least, have adhered to private development as a national policy.

Within the past few years, however, a change in thought as to the propriety of government ownership of waterpower development has been apparent. This was fairly strong during the long congressional contest which resulted in the adoption in 1920 of the Federal Water Power Act, but it had not then become powerful enough to prevent the writing into that act of the principle of controlled private ownership for long term leases of federal and navigable waters. It grew in strength during the as yet unsettled discussion as to the disposition of Muscle Shoals and of the Colorado River, and it flowered in California during two campaigns for state owned power, in both of which the private ownership view prevailed. In the East it gained some prominence, and a few adherents, when the Governor of Pennsylvania two years ago put forward as one of his major policies the development of what would eventually prove to be a state-owned Giant Power system.

None of these signs of growing interest in public power, however, have held as serious a menace to the principle of private ownership as the campaign which Governor Smith of New York started two years ago and which is now coming to a head. The Governor of New York is not a radical, as Governor Pinchot might be called. He is eminently a practical man, versed beyond most public men in both private business and the business of the state and close to the hearts of the people. Events of the past year have shown that he has a numerous following who, regardless sometimes of party affiliations, take his leadership. When he makes a major issue, as he apparently is getting ready to do with this waterpower ownership, it is better than a fair bet that he will have the people with him. The question of state ownership of power in New York State, therefore, now takes on more than the academic color it has in Pennsylvania and in California.

Governor Smith is opposing the present state waterpower act which, modeled on the federal act, permits the private leasing of state and border waters for 50-year periods under state control as to rates. In its stead

he proposes a semi-public corporation, similar to the Port of New York Authority, with power to borrow money on the state's credit and with authority to develop waterpower and to sell the electric energy therefrom. The proposal has met with almost unanimous approval by the newspapers of the state, and the tone of their editorials indicates a most significant change in public thought on this subject. These editorials might almost come from one pen, so similar are the arguments. They all emphasize two things: that the developments in electrical production, transmission and use are so rapid and amazing that it would be most unwise to put so much power in the hands of private interests for a period of 50 years and that the public control of rates through the public service commission has become so hedged about by law and precedent and formality that there is little assurance that the public is being protected against unfair charges.

If these were the opinions of a few radicals they could be discounted, but they are the opinion not only of the Governor of New York but of some of the citadels of conservatism among the metropolitan press. Evidently there must be some cause for what in most of the instances is a change of heart, and it behooves those who believe that government owned power is dangerously wrong to look for such a cause.

Many of these new converts, to be sure, are uninformed. They do not know, or choose to ignore the fact, that rates for electricity have been constantly going down under the present system of private control and that there is no evidence in the publicly owned plants, either here or in other countries, that government ownership produces cheaper electricity. They have, too, an exaggerated notion of the economies of hydro-electric generation. Most people apparently still believe that about all that has to be done to generate electricity from a river is to put a couple of wires in some falling water. Only a week ago one of the leading newspapers in New York editorially noted as evidence of the essential obliquity of privately owned power that the rates on water generated electricity in a small western city in the state are higher than for coal generated electricity in New York City, in dangerous ignorance of the possibility that the small hydro-electric plant might conceivably be more costly to build and to operate than the huge riverside coal plant. They know nothing about load factors or power factors or the necessity for the interconnection of coal and waterpower plants in the development of a balanced load. They do not realize that once the state starts to build one hydro-electric plant, and to distribute the energy therefrom, the economic demands of interconnection require it gradually to extend its ownership and control to all the power plants and transmission in the state, with the eventual establishment of a huge power expenditure that becomes the state's main business, to the control of which all other state functions must defer. If they do not believe this let them look at the province of Ontario.

But even if they do know these things the public owned power advocates see other things. They see the gradual establishment of great power combines, whose potentialities for evil they fear. They see the holding company, with its evident reduction of the cost of operation, too often made into a financial subterfuge which evades the public utility law's principle of a fair return by hiding profits in distributed charges and which brings immoral gain to the fortunate controlling few. Whether or not the privately operated plant can be run more economically and without the potential political subservience of public ownership, they are not particularly concerned. They are looking for some way to meet the growing danger of unified and unregulated private control of what is more and more realized to be of great, though frequently exaggerated, importance in the life of the people, the generation and distribution of electrical energy.

The writing is on the wall. Will the public utility interests interpret it? This is not a question of fighting the small municipally owned power plant with its obvious deficiencies that go with isolated production and ignorant political control. This is something that promises to grow beyond the mere generation of a few hundred thousand horsepower in the border waters of New York State, where conditions are most favorable to government owned power. It has the signs of the beginning of a long-time national movement which may lead to a revision of national policy, and a revision which it is not pleasant to contemplate. The railroads of the eighties had their Interstate Commerce Act; the trusts of the nineteen hundreds had their Sherman and Clayton Acts; the public utilities of the nineteen twenties may profit by their example.

Clarifying the Toll Bridge Question

"IN NO EVENT," says a report of the Metropolitan Planning Division of Boston, "would we favor any plan which would place the burden [of paying for a bridge or tunnel across the harbor to East Boston] upon the general taxpayer of the city or the district." This remark states the situation surrounding the present movement for building highway bridges and tunnels on the toll-refunding plan. The need and demand for road traffic crossings over major water courses have come so suddenly and in such magnitude that they exceed by far the ability or the willingness of the general taxpayer to provide for them. These demands are not the whims of boosters, but have real economic justification, as is shown in case after case by traffic studies and forecasts; yet if they must wait for tax money the desired crossings will have to wait for many years. On the other hand, traffic is ready and willing to pay for them—in fact, it is paying now, either in the form of ferry tolls or in the cost of detouring, or in restricted range of movement.

The Boston board's report, like that of the Rhode Island toll bridge commission which reported a few weeks ago, shows that there is need for a costly traffic improvement—connection of inner Boston with its northeastern outliers in the one case, and connection of the island with the mainland in the Bristol region in the other case—but that the improvement cannot come about on tax money. The same situation is found in dozens of other places throughout the country. The toll plan, in short, is the only way of catching up with the rapid growth of need for stream crossings and avoiding a serious throttling of road movement. Opposition to the toll plan, therefore, is untimely. But the plan, of course, is sound only if tolls are limited to the necessary refunding period and if the capitalization, whether private or public, is systematically reduced by the amortization earned.

Lockport Lock Construction Plant, Illinois Waterways

Lock Has Lift Gate and Wall Culverts—Large Plant Units Fitted Into Limited Space—Cableway Handles Seven-Yard Bucket

CONSTRUCTION of a concrete lock at Lockport, Ill., for the Illinois Waterway calls for a plant arrangement in close quarters and excavation against and partly undermining an old lock built a score of years ago of natural cement and rather alarmingly caverned by disintegration. The quantities include chiefly 171,000 cu.yd. of excavation and 96,600 cu.yd. of concrete with 30,500 lb. of reinforcement. There are 782 tons of structural steel and 112 tons of castings and forgings for gates, valves and their connections. The contract was let Oct. 8, 1923, and construction began the following day. The contract price was $1,460,000 and the contract time was set as three years. Construction is now more than half finished.

Lock Structure—The lock being constructed consists of parallel gravity-section walls some 938 ft. long, 110 ft. apart and 66 ft. high from foundation bed and has a lift of 41 ft. The sections and dimensions are shown by the drawings of Fig. 1. As indicated, the lower gates are the usual mitering type but the upper gates are vertical lift gates. The exceptional feature is the vertical lift gates, rare in American lock construction and a subject for separate consideration. Another noteworthy feature in design is the placing of the culverts in the lock walls. This simplified the lock floor construction to a thin concrete paving over the solid rock bottom, and reduced construction cost. A noteworthy detail also of the culvert construction is the Venturi tube design of the valve chamber which cuts down the valve dimensions. Other general details of design will be seen from the drawings. Here only construction methods and plant for the masonry work are considered.

Generally there is no complexity in the masonry work. The lock walls and gate emplacements are largely simple surfaces and the walls, galleries and culverts are plain rectangles or cylinders. No formwork of other than common shape and fabrication is required. Indeed some 500 ft. of both sidewalls are of substantially one section and two sets of traveling wall forms do for the entire 1,000 ft. The concrete is a gravel mix in proportions varying with the void content of the aggregate and running about 1¼ bbl. of cement a cubic yard. Concrete mixing and placing follow usual good prac-

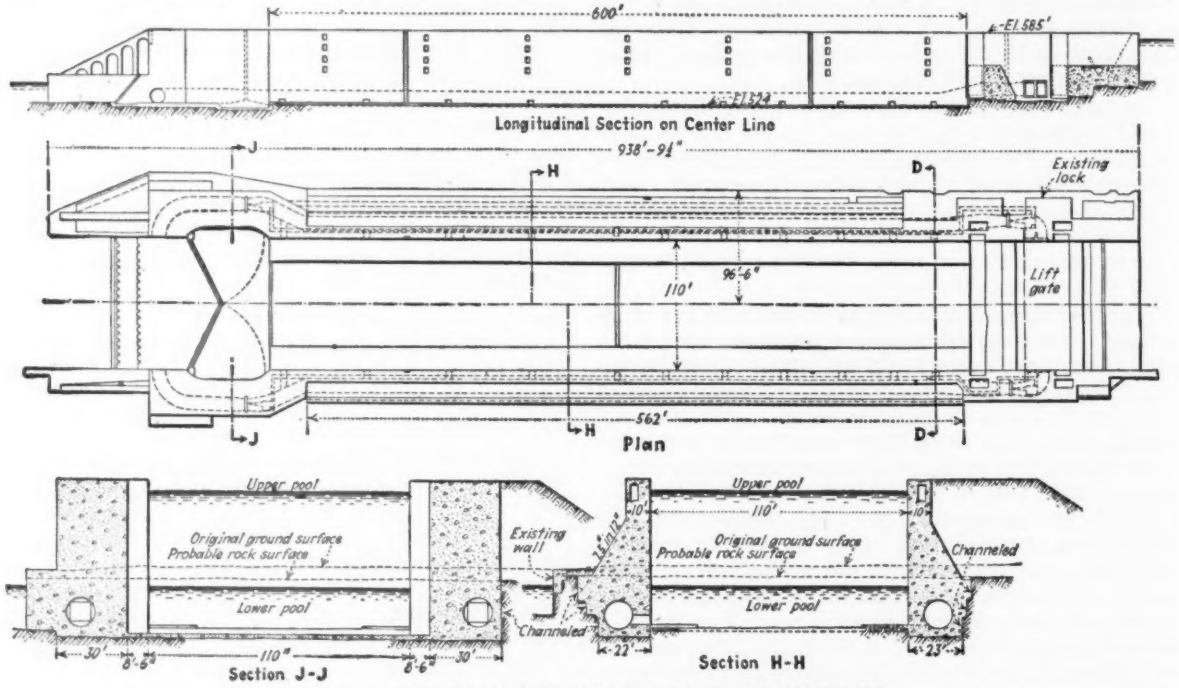


FIG. 1—LOCKPORT LOCK MASONRY PLAN AND SECTIONS
This lock, located at the end of the Chicago Drainage Canal, effects the first change in level in the new barge waterway from Chicago to the Illinois River at La Salle

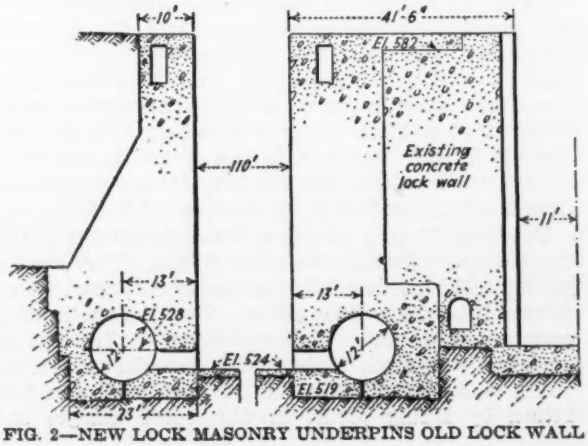


FIG. 2—NEW LOCK MASONRY UNDERPINS OLD LOCK WALL

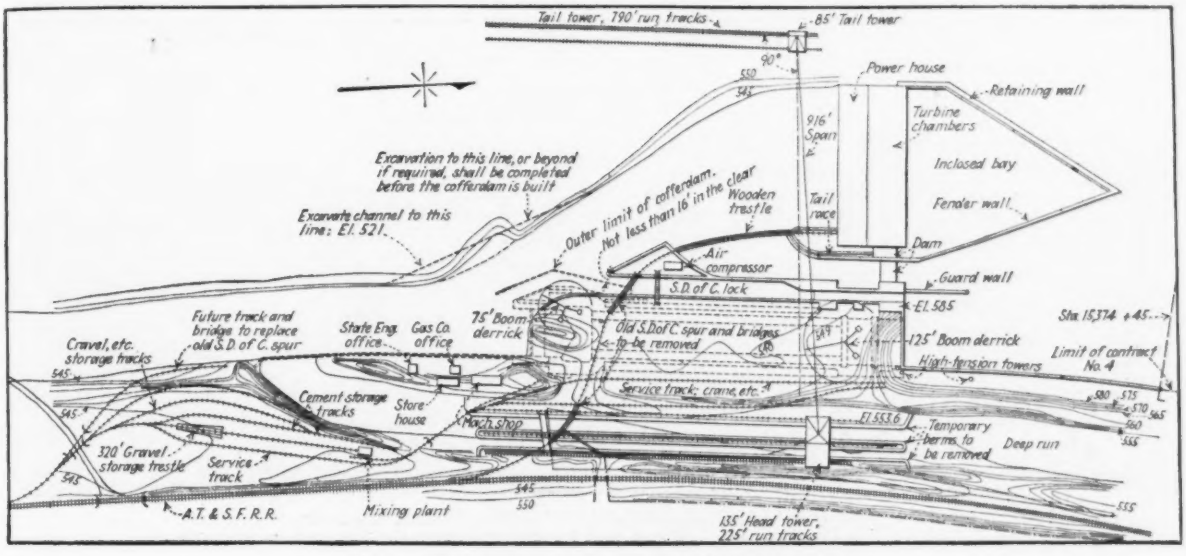


FIG. 3—STRUCTURE AND PLANT LOCATION MAP
The space restrictions on plant arrangement are strikingly apparent.

tice. No chuting, however, is permitted. In building the walls the stipulation is that the concreting be done in alternate 30-ft. sections. A special construction feature remarked in the specifications was the underpinning in alternate sections of the adjacent old lock close to the west wall of the new lock as described later on.

Plant Layout and Units—The contractors for the Lockport lock had recently finished the lock at Marseilles, Ill., and had a complete lock-building plant consisting of steam shovels, locomotives, cars, track, derricks, a mixing plant and a cableway as described in *Engineering News-Record*, Dec. 7, 1922, p. 962. The practical thing to do was to establish this used equipment as far as possible on the new operation having quite different conditions of locations. These are shown by the map, Fig. 3. Close on the west side of the new lock site were the lock and hydro-electric plant of the Sanitary District of Chicago and the district's tail race channel into the DesPlaines River. The old lock was idle but the power plant was in full and profitable operation. There could be then no constriction of the tail race channel or any interference with forebay conditions which might cut down the head on the power-house turbines. The map shows the strict limitations placed on tail race construction. On the west side of the new lock location there was no place for construction plant except for a unit which could be located across the river.

Virtually all construction plant must be placed east of the lock site. Here about 250 ft. away from the east lock wall is the track of the Santa Fé railway. Between the lock and the railway embankment is a stream known as Deep Run, a creek emptying into the tail race channel. This creek bed and borrowed railway right-of-way and borrowed land belonging to the Illinois Steel Co., a narrow shore strip altogether about 2,000 ft. long and not over 250 ft. wide, was all the room for plant location. It was utilized as shown on the map by filling in a strip of the creek bed, thereby taking the risk of overflow. In brief the plan is: (1) A cableway track on the west bank of the river and another on a fill in Deep Run and a cableway spanning the lock site, (2) a mixing plant and stockpiles on the east bank south of the lock, (3) a track system fanning out from a Santa Fé switch to the mixing plant and stock areas, under the cableway and into the lock pit, and (4) derricks in

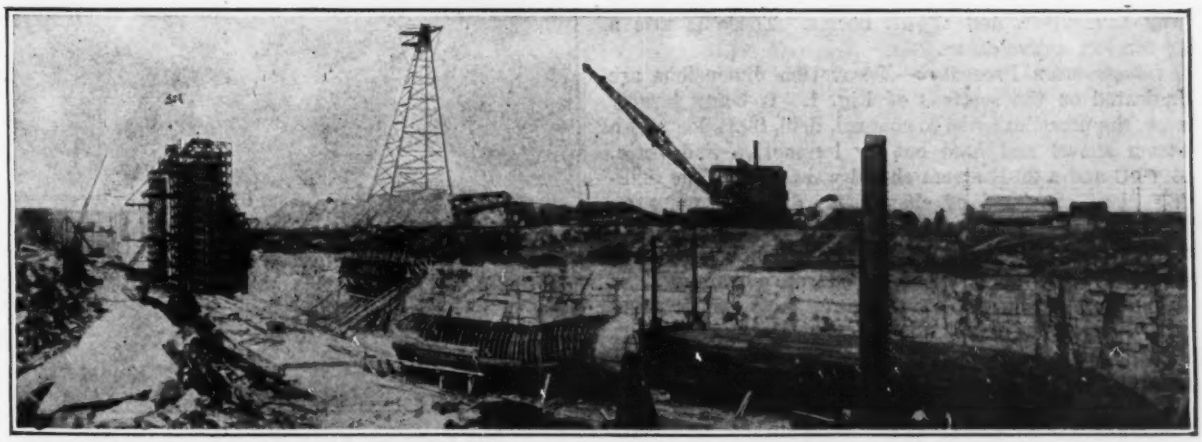


FIG. 4—BEGINNING OF EAST LOCK WALL CONSTRUCTION
Note the simultaneous excavating and concreting operations, traveling wall forms of steel and culvert form.

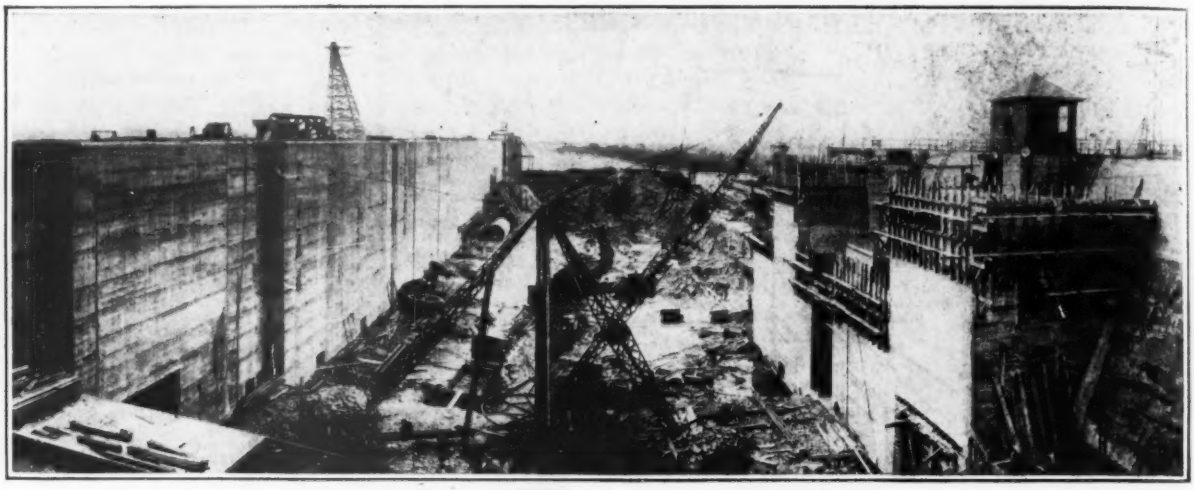


FIG. 5—EAST LOCK WALL CONSTRUCTION NEAR ITS END
Excavation still proceeding. Block of new wall being built against old lock wall on west side.

the lock pit to handle work out of direct reach of the cableway.

The two larger plant units are the mixing plant and the cableway. The mixing plant and gravel stockpile trestle are virtually those used at the Marseilles lock and shown by drawings in *Engineering News-Record* Dec. 7, 1922, p. 962. A belt conveyor under the gravel trestle delivers to the boot of a bucket elevator which carries to a bin above the mixers. Cement coming in bulk in cars is similarly elevated to a bin over the mixers. The mixers below the bins are duplicate 1-cu.yd. units and are charged from separate measuring boxes under the bins. They discharge high enough for a car with bucket to take the concrete and carry it to cableway and derricks. The mixing plant is a notably compact unit and having two mixers, each with its separate power, continuity of concreting is assured.

The cableway is electrically operated, with central control of both towers, by one operator. Its main dimensions are: Head tower 135 ft., tail tower 85 ft., span 916 ft., main cable 2¾ in., and travel 1,000 ft. The working load is 16 tons and the capacity is 30 tons. Virtually every kind of construction material has been or will be handled by the cableway but principally it handles concrete, excavation reinforcement and form material. The two derricks supplementing the cableway have 75-ft. and 125-ft. booms. There is also a 20-ton locomotive crane.

Construction Procedure—Excavation dimensions are indicated on the sections of Fig. 1. It being largely rock, the procedure was to channel, drill, blast, load with steam shovel and haul out by locomotive and train. A 70-C and a 20-B steam shovel were used. The drilling plant consisted of channelers, drills in pairs on quarry bars for deep holes, jackhammers for lighter work, a central compressor plant, portable compressors and drill sharpeners. The methods were ordinary. In general a cut was made for the east wall emplacement and widened out across the lock and about as soon as enough foundation was clear for effective work, wall concreting was begun. Indeed as shown by the views Figs. 4, 5 and 6, excavation and concrete placing have continued side by side up to the stage shown.

About the only special care in excavation was in channeling the sides and in digging near the wall of the old lock. Fig. 4 shows the channel cut of the east wall. The culvert form is being built and farther north are the steel wall forms. In digging next to the old lock wall the old masonry had, as shown by Fig. 2, to be undercut. The specifications required this undercutting to be done in alternating sections of not over 30 ft. and the masonry placed before excavating the intermediate sections. This proved a wise requirement as the natural-cement walls of the old lock were found to be very shaky in spots through disintegration. In Fig. 5 the right-hand block of concrete is being built under and against the old lock wall. This is a view looking south. To the left is the nearly completed east wall just being begun on the right of Fig. 4.

In concreting, cars carrying the 7-cu.yd. buckets shown by Fig. 6 are loaded at the mixing plant and hauled under the cableway, which picks off the bucket and handles it into place for pouring. The bucket

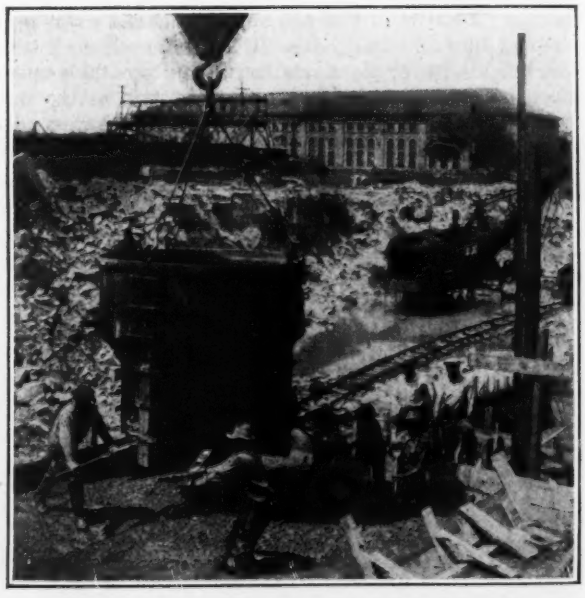


FIG. 6—SEVEN YARD CONCRETE BUCKET
Loaded, this bucket weighs 16 tons. It is transported by car from mixing plant and handled to the place of pouring by cableway.

loaded weighs 16 tons. By this method a rate of 90 cu.yd. an hour has been attained. Except for the mid-sections of the sidewalls (see Sec. H-H, Fig. 1) wood forms are used as indicated on the right in Fig. 5. There are two sets, each 30 ft. long, of the traveling, standard-wall, steel forms. The three views indicate concreting operations sufficiently well. Indeed it has been altogether a straightforward operation.

So far only the portion of the lock chamber on land has been under construction. There has been remarkably little water but the contractor has had ready several 2-in. to 10-in. pumps of the electrical vertical submerged type. With the extension of the lock construction out into the tailrace channel there will be cofferdamming and pumping. Fig. 3 shows the restrictions put on tailrace construction.

In general construction has not been, nor is it being, crowded. The situation of the waterways operation is such that the lock will be completed long before it can be used and there is no gain in pressing the progress beyond easy accomplishment.

Direction—The lock is being built by the Illinois Division of Waterways and is a structure in the new barge waterway from Chicago to La Salle, Ill. The chief engineer is M. G. Barnes and Walter M. Smith is chief designing engineer. On the Lockport work R. S. Heath is resident engineer and Fred Hendershot is assistant engineer. The contractors are Green & Sons Co., Chicago, with Roy Shackelton general superintendent, R. A. Bonnell, engineer, and C. C. Green, superintendent. A general description of the Illinois Waterways was published in *Engineering News-Record*, Dec. 2, 1920, p. 1095.

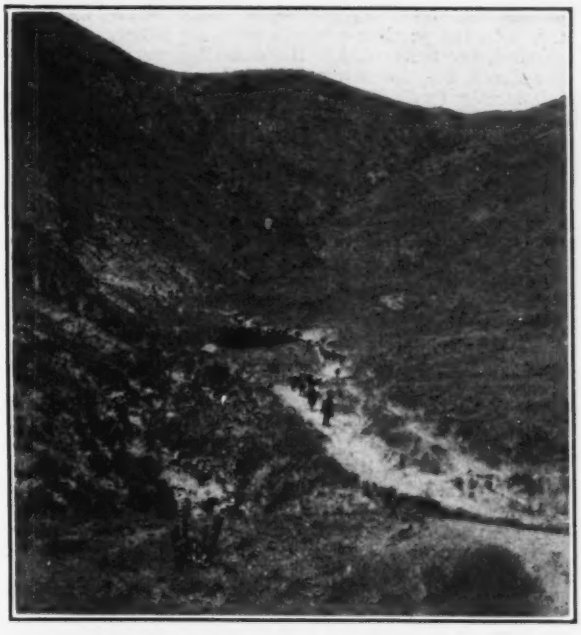
Helping Uncle Sam Adjust the Tacna-Arica Boundary

AN AMERICAN engineer attached to the boundary survey party of the Arbitration Commission of the famous Tacna-Arica dispute, writes home of some of his experiences that will interest young engineers with a hankering for foreign service. Ultimately the territorial limits of Peru and Chili are dependent on the surveys of engineers. General Morrow has in charge the boundary survey of which little is heard while all the publicity has centered on General Pershing's plebiscite duties. Certain excerpts from the engineer's letter, which was written at Tacna, Chili, Dec. 12, follow:

More as an adventure than anything else I undertook this work and I am sure this expressed the sentiment of the rest of the fellows. The whole boundary dispute arises out of the War of the Pacific so-called, which took place back in 1879 between Chile and Peru. I must admit that previous to accepting this job as draftsman I had never heard of this particular South American war although I did know that revolutions were the popular thing in these parts. However, General Morrow said that we would receive safe conduct in this bad man's country so I did not hesitate to accept.

The work of the commission is divided into two parts, that of the plebiscite under General Pershing and that of the boundary survey under General Morrow. To date the work has been very disappointing in its accomplishments with many incidents to disturb the peaceful carrying out of President Coolidge's award, as arbitrator. We have two engineering parties out in the field doing triangulation and plane table work, the country is terrible and the transportation problem is a big one. The general character of the country is desert in the valley with rolling foothills of sand and gravel, which repeats itself even away up in the altitudes. Dry river beds are everywhere and there are no signs of vegetation or animal life, until one gets up to 10,000 ft. of more. Here an occasional village (Indian) is found where the inhabitants live a precarious existance in the most primitive fashion. I have made several trips to Tarata, a small Indian village about 75 kilometers north of Tacna. The first time I made the trip I nearly had heart failure. Such roads and passes I have never traveled over before. Tarata is the base for our party and we have to transport all our food supplies including forage for 50 mules and horses as there is insufficient food for man or beast in that vicinity.

Very little accurate information is available about the geography of the two disputed provinces and the existing maps have proved to be at variance in many instances with the results the field parties have obtained. South America is in a similar position to that of the United States back,



TYPICAL COUNTRY WHERE AMERICAN ENGINEERS ARE ESTABLISHING BASIS FOR CHILE-PERU BOUNDARY
Reconnaisance party on the road has to carry food for men and mules over the desert which extends up to 10,000-ft. altitudes.

say, in 1849, but there is much development going on, particularly by American engineers of whom there are many down here.

We expect to leave for home this month (December), because of the bad weather in the mountains. The peaks have been obscured by clouds while rain and snow have added to the hardships so that in a few days it will be impossible to do any work. The boys are all anxious to get in. The work will not be resumed until next April. In the meantime we will all depart for America, some to go home and others to wait orders in Washington. I am not so sure many of them will be at all anxious to come back here.

Typhoid and Malaria in the Philippines

During 1924, there were reported to the Health Service of the Philippine Islands 3,162 cases and 1,923 deaths from typhoid fever, giving case and death rates of 28 and 17 per 100,000 and 60.8 per cent of fatalities. Similar data for malaria show 70,262 cases and 26,740 deaths, with case and death rates of 625 and 238 per 100,000 and a fatality percentage of 38.1. Figures by month and for the year are given in U. S. *Public Health Reports* for Dec. 25, 1925.

Highway Relocation Practice in Pennsylvania

Procedure Followed in Line Rectification When Road Reconstruction Is Required by Wear or Traffic

By W. W. Crosby
Location Engineer, Pennsylvania Highway Department, Harrisburg, Pa.

Extract from a paper presented at the Annual Convention, Chicago, Ill., Jan. 11-14, 1926, of the American Road Builders Association.

THE improvement of a section of state highway is contemplated by the proper authority and a study of facts is authorized. Such suggestions as to the routing or alignment, with the possible controls affecting either, as can be furnished, are forwarded to the district engineer. The latter secures the necessary field information and reports preliminarily (with Form 468 and a proper sketch map to illustrate the situation) through the division engineer to the location engineer. The latter advises the district and division engineers in the field during this work as may be found desirable from time to time. The conclusions of the location engineer, with a summary of the facts and his recommendations, are then sent with the supporting data to the engineering executive for his decision and transmittal to the secretary of highways and the governor. When the approval of the latter is had, the district engineer proceeds to complete the construction drawings on the location thus determined.

A specific example will best illustrate the procedure followed and the criteria involved in recommending relocation. As shown by the map, state highway route 153 was established by the Legislature to begin at Philadelphia near Chestnut Hill, and "thence running by way of Fort Washington, Spring House, Montgomeryville and Colmar to a point on the dividing line between Montgomery and Bucks Counties; thence to Line Lexington, Sellersville, Rockhill and Quakertown, to a point on the dividing line between Bucks and Lebanon Counties; thence by way of Coopersburg to a point on the boundary line of the city of Allentown, Lebanon County."

It has been held by the legal authorities of the state that the highway department must improve or maintain the route between Philadelphia and Allentown *as identified* by the legislative description, though the improved roadway may vary from the original or present public road or right-of-way between those points, *provided that*, if the new highway shall be relocated so as to bypass the intermediate villages or boroughs named, a proper connection or spur shall be provided by the state between each of these settlements and any relocation for the state highway.

Now in this case it appears that previously a modernly-paved roadway has been provided along the right-of-way of the old road from the point of beginning (the Philadelphia city line at Chestnut Hill) for 7 miles to Spring House on route to Allentown, 41 miles from Philadelphia, and that this roadway is satisfactory for the present requirements. From Spring House to Quakertown, 20 miles, the present roadway is in such condition as to be reasonably sufficient for the present and no improvement is contemplated by the state for this section at present. The existing roadway of the established route from Quakertown to Center Valley, 7 or 8 miles is in such condition that its resurfacing must be done by the state at once. From Center Valley to Allentown, 6 miles, the existing road (recently improved) may be taken as outside the present consideration.

The question that first arises, therefore, is: what location or alignment shall be contemplated for the section of new roadway now to be provided on this route for the part between Quakertown and Center Valley?

Philadelphia, the third city in population of the United States, is of course a large center of production and consumption. Allentown is a growing center, and with Bethlehem less than five miles away forms an important region for production and consumption. The distance between the two regions (Philadelphia and Allentown-Bethlehem) is well within the radius of efficient motor trucking operations over a direct connection by improved public highway. Such operations demand several provisions to be made properly; directness; avoidance of unnecessary length or excessive curvature and grades; sufficient widths; avoidance of local congestion and of danger; together with proper regard for local convenience and use of this route which for the present must be considered as a general purpose highway.

It, therefore, seems necessary before the propriety of the present location of a section of the entire route can be determined, first to examine the route as a whole.

The Transport Surveys (of 1923 and 1924) show the figures of the accompanying table as regards the traffic use of this route. It is apparent that the route may be regarded (relatively at least) as a heavily traveled route, and one on which future traffic is to be much more severe and numerous within the life of the more durable roadway now proposed to be built. The improvement of the roadway will accentuate these conclusions.

The present alignment of the route between the termini—and in some cases between the intermediate points mentioned in the Act—is somewhat indirect and thus excessively long; the grades on the present alignment are more

TRAFFIC CENSUS OF ROUTE 153, PHILADELPHIA-ALLENTOWN

Location on Route		Average Sunday (Total)	Average Daily (Total)	Average Daily Trucks
		1923		
At Chestnut Hill		4,402	2,552	505
Near Valley Creek		3,758	2,014	404
At Spring House		3,710	1,650	338
At Montgomeryville		2,930	938	154
Near Sellersville		2,653	1,008	145
At Rich Hill		2,811	1,230	135
At Quakertown		2,857	1,168	139
At Coopersburg		3,127	1,430	291
At Allentown		2,816	1,878	367
		1924		
Near Spring House	Trucks	129	115	122
	Passenger Cars	1,573	727	1,150
	Total	1,702	842	1,272
At Sellersville	Trucks	155	113	134
	Passenger cars	1,373	730	1,052
	Total	1,528	843	1,186
Coopersburg	Trucks	208	158	183
	Passenger cars	1,679	1,013	1,346
	Total	1,887	1,171	1,529

severe than are now, or are likely to be, satisfactory; and congestion and dangerous situations for all traffic exist at numerous places along the present alignment. Discomfort, dissatisfaction and inconvenience also are suffered by the residents along the present roadway from the conflict of interests between the through or foreign traffic and the local enjoyment of the roadway. Reference now to the accompanying map showing the route, its controls, and the topography reveals the following:

An air-line from the center of gravity of Allentown and Bethlehem to Philadelphia passes through or close to Center Valley. The latter point is in a gap in the hills through which the route must come from the south into Allentown and Bethlehem, and it also forms a convenient point for diverging from the air line by Y's or branches to the industrial centers of both these towns, which are about five miles apart and each practically the same distance from Center Valley.

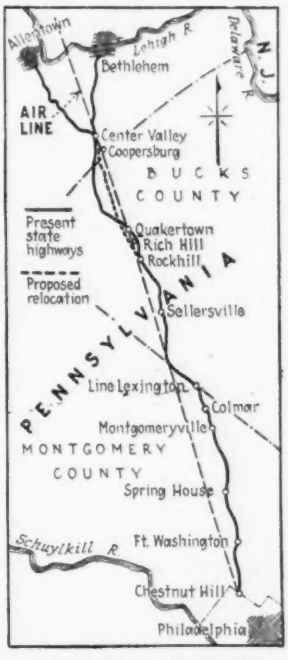
From Center Valley south to Philadelphia the air line would pass east of the present location in the village of Coopersburg; through Quakertown; a little west of Rock Hill and of Sellersville; be nearly coincident with the present location at the Bucks-Montgomery County line; and then lie to the west of Line Lexington and of the present route through Montgomeryville, Colmar, Spring House and Fort Washington, to coincidence again at the Philadelphia city line.

It has been noted that a roadway satisfactory for present needs exists south of Quakertown. The present problem is, therefore, the location above Quakertown to Center Valley, both these points being coincident on the present route and the air line. Whatever the future may hold for relocation below Quakertown (to Philadelphia), evidently no consideration of that section need now be included with that of the section from Quakertown to Center Valley.

Within the limits so arrived at for study as to improvement now with a durable type surface (i.e. between Beaver Run, south of Quakertown and Center Valley), the air line

is 6.65 miles or a mile less than the length of the present road. This air line appears impracticable as it cuts Quakertown and Coopersburg diagonally, which would cause excessive property damage and also introduce difficult and dangerous traffic conditions due to passing through thickly built-up parts of the boroughs. It further introduces two railroad crossings with consequent problems and complications; does not fit the topography to advantage; creates a duplication of nearly parallel roads in certain narrow sections; does not serve rural interests to advantage, beside causing excessive property damages.

A study of the topographic maps available, and covering a section between Rich Hill (just south of Quakertown) and Center Valley, enables a suggestion to be made for a relocation on an approximate air line between these points that will offer many advantages, along the lines indicated before as desirable, such as greater directness, shorter lengths, better grades, avoidance of congestion and other dangers to traffic. The relocation so suggested will also bring this section of the route very closely in alignment with the direct route needed between the termini of Philadelphia and the Allentown-Bethlehem region, so that its improvement now would seem to form a real step toward what may be considered as an ultimately desirable establishment, though for some years to come the rest of the establishment may not be completed and the present character of the highway as a general purpose one, but not a special industrial highway, may be retained and that function of it served.



SKETCH MAP SHOWING TYPICAL ROAD RELOCATION

A preliminary field survey of the suggestion developed from the maps was therefore authorized, and was made by the district engineer's forces. The location report shows the following in support of a relocation proposition:

The relocation (the approximate air line) shown on the attached print is in conformity with the requirements of the existing legislative act establishing this route.

Scenic and similar considerations on the proposed relocation are equivalent to if not better than such features along the present route location.

The proposed location will avoid, for through traffic, one grade and two half-grade crossings with the Lehigh Valley Transit Co. (Liberty Bell Route) which exist on the present location of the route. However, the relocation will require the creation of a new grade crossing with the Lehigh Valley Transit Co. at a point to the northwest of Quakertown Borough. The present route, through the latter place parallels the trolley tracks and consequently there is created a rather undesirable congested traffic condition along the present narrow built-up street (33 ft. between curbs). The relocation avoids this unsatisfactory feature entirely.

The character of the country traversed by the relocation is mostly farming land and low land. Between the termini of the two locations there are thirteen houses and two schools along the relocation, and 143 houses, 5 churches and 2 schools along the present route. Either of the locations serves Coopersburg (89 houses) and Quakertown (97 houses).

The length of the present route is 52,712 ft. or 5,012 ft. more than the length of the relocation (47,700 ft.) which is an appreciable saving in favor of the latter on this important primary route. It will further be noted that the relocation as proposed conforms very closely to an ideal air line location between Center Valley and Rich Hill.

The maximum grade on the present road is 7.94 per cent, which extends for a continuous length of 1,025 ft., whereas on the relocation the maximum grade will not exceed 8 per cent, for a length of 600 ft.

The proposed line, in Quakertown Borough, will avoid an exceptionally sharp curve in a narrow and built-up section. This undesirable and dangerous condition that exists along the present route cannot be modified sufficiently satisfactorily without involving excessive property damages. Alignment along the relocation is a vast improvement over that along the present route, the maximum degree of curvature being one nine-degree and thirty minute curve on the former as against a maximum of three fourteen-degree curves on the latter (exclusive of the sixty-degree curve in Quakertown Borough).

It is estimated that the cost of construction on the present location would be $424,385 or $16,241 more than the estimated construction costs via the proposed relocation ($408,144).

The present daily traffic is reported as 1,346 passenger cars and 183 trucks. The probable future daily traffic is estimated as 2,700 passenger cars and 400 trucks. Predicated on the latter traffic figures the economic formulas of this Department show the following annual operation costs:

	Present Route	Proposed Relocation
Passenger cars	$941,654	$852,026
Trucks	531,195	476,552
	$1,472,849	$1,328,578

or an annual saving of $144,271 in favor of the relocation.

The value of the land traversed by the relocation is about $125 to $200 per acre for farming land and about $50 per acre for marsh land, I am informed. The total land damages involved in obtaining the necessary lands for ultimate right-of-way purposes on this location would amount to approximately $15,350. In addition, the moving back of buildings to obtain a 100-ft. right-of-way would involve about $12,000 on the relocation. The average value of the land necessary to widen the present road to a 100-ft. right-of-way width with the incidental minor line revisions is about $150 an acre, involving total land damages of $12,300. Property damages on this location, because of the built-up conditions now prevalent, would amount to about $285,600 in order to obtain the prescribed ultimate right-of-way width. Ultimate damages, therefore, would be $270,550 more along the present route location than via the relocation.

No abnormal maintenance conditions nor unusual construction difficulties would be encountered along either of the locations considered.

Lack of Improvement Program Costs Money

A warning as to the expensive experience of carrying out public works at haphazard, instead of upon a definite program, is contained in the following quotation from the annual report of W. P. Cottingham, city engineer of Gary, Ind. This report shows that during 1925 the Board of Public Works awarded 81 contracts aggregating $1,720,397, distributed among 17 contractors; 30 contracts uncompleted at the end of the year represented a total of $620,902 to be carried forward into 1926: "The lack of a predetermined program for public improvements was keenly felt in this [the engineering] department during the past season. No opportunity was given during the winter months to prepare careful plans for various approved projects, and consequently many contracts were awarded for improvements before the plans were finally completed in the detail necessary. This resulted in a disturbance of approximate quantities for bidding purposes that in one case made it appear that one type of pavement was low on the bid, while it was considerably higher on the final estimate. During the winter months more careful checking is possible with the organization available and plans are prepared with greater attention to detail and accurate quantities than when rushed through under pressure of orders to proceed at once."

1925 Drought Breaks All Records in Southern Appalachians

Crops, Pastures, Water Supplies and Power Suffer and Forests Burn—Average Deficiency for 12 Stations 37 Per Cent

By E. D. Burchard

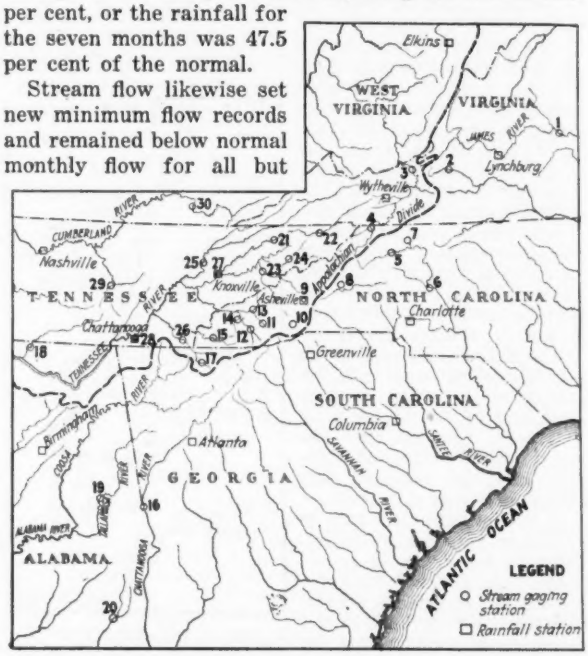
District Engineer, Water Resources Branch, U. S. Geological Survey, Asheville, N. C.

RECORDS of stream flow in the Southern Appalachians collected by the Water Resources Branch of the U. S. Geological Survey, in co-operation with the states of North Carolina, Tennessee, Virginia, and other agencies during 1925, show that stream flow in general reached a minimum during the present year that was lower than any accurately recorded before. Old inhabitants at widely separated points affirm that similar flows occurred during 1881. The single comparative record available, however, shows the recent drought to have been the worst. Crops save in the bottom lands were failures, pasturage was practically destroyed and many wells, springs and creeks that had never been known to go dry ceased to flow. Numerous municipal water supplies received heroic first-aid treatment to maintain even their minimum requirements and power companies had the worst water year of their experience. Rigid economies were applied to power distribution and periodic shut-downs beginning early in August were enforced by one large company to relieve the situation.

Spectacular and costly forest fires in midsummer resulted from the protracted period of deficient rainfall. Reports from eight counties in western North Carolina show that 17,000 acres of timber were burned over at an estimated loss of $200,000, at a season of the year normally free from fire hazard.

Precipitation records of the United States Weather Bureau show a minimum rainfall for the climatic year ending Sept. 30, 1925, for all stations in this area. Monthly deficiencies were general throughout the year except in December and January. A few stations report deficiency in these months and a few others show excess in July. The drought centered in the mountains and conditions were partly relieved there before the severest effects were felt in adjacent areas that had received excess rainfall during the early winter. Table I shows the monthly departure in inches from normal precipitation at 12 selected stations during the year ending Sept. 30, 1925, the total deficiency during the year and the percentage of deficiency on the basis of normal annual rainfall. The average percentage of deficiency for the 12 stations is 37 per cent. If the Elkins station is eliminated, the average is very nearly 40 per cent; or the rainfall for the year over the Southern Appalachians was about 60 per cent of normal. Inspection of the table shows that, after January, rainfall in excess of normal occurred at only three stations, Elkins, Birmingham, and Nashville. The percentages of deficiency for the period February to September have been computed and the average found to be 49 per cent for the 12 stations. If the Elkins station, which shows excess in three of the seven months, is eliminated, the percentage of deficiency for the remaining stations is 52.5 per cent, or the rainfall for the seven months was 47.5 per cent of the normal.

Stream flow likewise set new minimum flow records and remained below normal monthly flow for all but two months of the year. Table II shows the monthly discharge of French Broad River at Asheville, N. C., during the year ending Sept. 30, 1925, compared with the average monthly discharge based on 16 years of record and also a comparison month by month with the lowest monthly discharge of the 16 years. It will be noted that the monthly discharge during 1925 was below the



LOCATION OF RAINFALL AND STREAM GAGING STATIONS IN SOUTHERN APPALACHIAN STATES

TABLE I—MONTHLY DEPARTURE IN INCHES FROM NORMAL PRECIPITATION AT SELECTED STATIONS IN SOUTHERN APPALACHIANS DURING YEAR ENDING SEPT. 30, 1925

	Elkins, W. Va.	Lynchburg, Va.	Wytheville, Va.	Asheville, N. C.	Charlotte, N. C.	Greenville, S. C.	Columbia, S. C.	Atlanta, Ga.	Birmingham, Ala.	Chattanooga, Tenn.	Knoxville, Tenn.	Nashville, Tenn.
October	—2.2	—0.9	—1.9	—1.3	—2.7	—2.4	—1.7	—1.7	—2.3	—2.6	—1.6	—2.4
November	—0.2	—1.3	—0.8	—1.9	—1.5	—2.3	—1.3	—2.6	—3.4	—2.6	—2.8	—2.6
December	—0.7	+0.1	—0.8	+1.0	+0.5	+1.1	+3.5	+1.7	+2.3	+3.4	+4.3	+1.5
January	+0.8	—0.3	—1.9	—0.1	+2.6	+2.6	+6.7	+6.3	+2.3	—0.8	—1.2	—2.2
February	—1.2	—2.4	—3.1	—1.4	—2.5	—4.0	—3.5	—3.2	—1.4	—2.4	—2.3	+0.6
March	—0.2	—2.8	—3.8	—1.5	—2.2	—2.3	—2.8	—1.8	—0.3	—3.8	—4.5	—2.1
April	—0.0	—0.6	—1.5	—0.8	—1.1	—0.9	—1.6	—2.8	—2.5	—2.2	—2.3	—0.6
May	—1.4	—2.6	—2.3	—1.4	—2.3	—2.6	—0.0	—1.5	—0.6	—1.9	—1.3	—1.6
June	+1.1	—1.1	—1.3	—2.2	—2.8	—4.0	—3.5	—2.5	—1.6	—1.9	—2.4	—2.2
July	+0.2	—0.5	—0.8	—4.0	—4.9	—3.2	—2.6	—2.0	+0.8	—0.2	—2.8	—2.6
August	—2.5	—3.7	—3.2	—4.4	—2.2	—5.1	—5.8	—4.5	—3.8	—2.5	—2.4	—2.4
September	+1.7	—3.2	—1.8	—1.0	—3.0	—1.4	—1.6	—3.3	—2.8	—1.4	—0.3	—0.2
Total deficiency	4.6	19.3	23.3	18.9	22.1	24.5	14.2	17.9	13.3	18.9	19.6	16.8
Normal annual rainfall	42.8	43.4	46.7	41.1	49.2	54.5	46.1	49.5	49.3	50.6	49.4	48.5
Percentage of deficiency	11	44	50	46	45	45	31	36	27	37	40	35

TABLE II—COMPARISON OF MONTHLY DISCHARGE OF FRENCH BROAD RIVER AT ASHEVILLE, N. C.

For the year ending Sept. 30, 1925, with average monthly discharge during 16 years, and with previous minimum monthly discharge during 16 years.

Month	Average Monthly Discharge 16 Years, Sec.-Ft.	Previous Minimum Monthly Discharge, Sec.-Ft.	Year* (a)	Discharge During 1925 Monthly Sec.-Ft.	Percentage of Average	Percentage of Previous Minimum
Oct.	1,640	836	1924	1,390	85	166
Nov.	1,430	679	1923	981	69	144
Dec.	2,460	914	1918	1,980	81	217
Jan.	2,570	1,500	1914	3,370	131	225
Feb.	2,600	1,540	1911	1,940	75	126
March	2,880	1,420	1911	1,650	57	116
April	2,720	1,440	1910	1,260	46	88
May	2,190	1,330	1914	1,150	52	86
June	1,850	1,020	1911	726	39	71
July	2,240	915	1911	590	26	64
Aug.	1,460	884	1914	328	22	37
Sept.	1,460	729	1914	371	25	51
Year	2,120	1,400	1914	1,310	62	94

*Years ending with September.

average in every month except January and that the flows for the six months, April to September, supersede the previous minimum flows for those months. The discharge for August was the lowest ever recorded for any month.

Table III shows the minimum discharge recorded during the year ending Sept. 30, 1925, at selected gaging stations in the Southern Appalachians compared with the minimum discharge previously recorded at the same stations. At the stations selected the flow was not affected by artificial regulation. The comparisons show that at all stations except two the minimum during 1925 was lower than that previously recorded.

Conditions of drought were materially relieved in the mountain area the first week in October at the time when conditions were at their worst toward the coastal plain. General rains the last of the month broke the drought and rainfall the first half of November was equal to the normal for the entire month.

Tabulated data for Tennessee, Kentucky, Alabama, and part of Georgia were furnished by Warren R. King, district engineer, U. S. Geological Survey, Chattanooga Tenn., and data for Virginia by J. J. Dirzulaitis, associate engineer, U. S. Geological Survey, Charlottesville, Va.

TABLE III—COMPARISON OF MINIMUM DISCHARGE DURING 1925 WITH PREVIOUS MINIMUM DISCHARGE AT SELECTED GAGING STATIONS IN SOUTHERN APPALACHIANS

No. on Map	Gaging Station	Drainage Area Sq. Mi.	Years of Record	Minimum Discharge 1925 Sec.-Ft.	Minimum Previously Recorded Discharge Sec.-Ft.	Minimum Previously Recorded Year	Percentage 1925 of Previous Minimum
	Virginia						
1	James River at Cartersville	6,230	26	500	603	1897	83
2	Roanoke River at Roanoke	388	29	40	.....	1909	..
3	New River at Eggleston	2,920	6	510	652	1917	78
	North Carolina						
4	New River, S. Fork, near Crumpler	325	8	100	205	1911	49
5	Yadkin River at North Wilkesboro	500	8	169	184	1905	92
6	Yadkin River at Salisbury	3,400	30	700	900	1897	78
7	Fisher River near Dobson	109	4	17	42	1923	40
8	Linville River at Branch	65	3	8	23	1924	35
9	French Broad River at Asheville	949	16	239	380	1907	63
10	Davidson River near Brevard	41	5	15	37	1922	41
11	Tuckasegee River near East Laport	200	5	36	103	1922	35
12	Little Tennessee River at Franklin	297	9	82	183	1923	45
13	Ocanalufty River at Cherokee	133	5	62	78	1922	79
14	Nantahala River at Almond	177	13	80	115	1922	70
15	Valley River at Tomotla	106	14	18	22	1904	82
	Georgia						
16	Chattahoochee River at West Point	3,300	30	224	780	1896	29
17	Toccoa River near Dial	175	13	60	109	1914	55
	Alabama						
18	Elk River near Elkmont	1,700	10	95	105	1904	58
19	Tallapoosa River at Sturdivant	2,460	26	75	250	1904	30
20	Choctawhatchie River at Newton	720	5	75	122	1922	61
	Tennessee						
21	Holston River near Rogersville	3,060	23	560	490	1904	114
22	Holston River, S. Fork, at Bluff City	828	25	140	160	1904	88
23	French Broad River near Newport	1,740	10	300	440	1904	68
24	Nolichucky River near Greeneville	1,100	12	247	305	1904	81
25	Clinch River at Clinton	3,090	7	360	340	1919	106
26	Ocoee River at Emf	530	13	144	285	1914	51
27	Tennessee River at Knoxville	8,090	26	1,300	1,550	1904	84
28	Tennessee River at Chattanooga	21,400	50	3,980	4,800	1881	83
29	Collins River at Rowland	800	8	50	60	1922	83
	Kentucky						
30	Cumberland River at Cumberland Falls	2,010	14	15	30	1922	50

Why Land Speculators and Unfit Settlers Hurt Reclamation

Describing troubles that arise on western irrigation projects from incompetence of settlers, Dr. Elwood Mead, commissioner of reclamation, said before the Western Society of Engineers recently: "On a project which we are trying to salvage, I recently went over the list of occupations of the early settlers. The first was a deep-sea diver, the next was the wife of an itinerant baseball player, the third had been a missionary in China. A defunct bank owned several farms. A painter, a plumber, a carpenter, all living in distant cities, owned farms, all unoccupied and untilled. A transient trained nurse had invested her savings in one of these speculative temptations. She had neither the money nor the inclination to do more. None of these people have paid water charges or delinquent county taxes for three to five years. Creation of a great agricutural community or the solvency of an irrigation project cannot be secured with this kind of human material. On projects like this the fundamental problem is to get real farmers to replace these derelicts who have given up hope but linger on, like Micawber, waiting for something to turn up. In one neighborhood there are 70 abandoned farms and a lack of morale everywhere. If an expert practical committee had selected the settlers and they had been advised about their work, there would now be no important salvage program or possible loss to either settlers or the government. The deep-sea diver would have stuck to his element and the bank would not have failed."

Engineering in the Small City

A series of notes from the field on the Problems and Practices of the Municipal Engineer in the Cities Below 100,000

The Editor Visits the City Engineer

Snapshots of Our Representative Small Cities

BURDICK ST., KALAMAZOO, MICH.

Kalamazoo, Mich.

A CITY OF DIVERSIFIED MANUFACTURING in southwestern Michigan located almost exactly midway, 150 miles, between Chicago and Detroit, on the main line of the Michigan Central R.R. It is the county seat of Kalamazoo County, the location of the state insane hospital, having 2,500 patients, the Western State Normal with 3,200 students and Kalamazoo College with 600 students. The city is on both sides of the Kalamazoo River but lies mainly to the west since the river hugs high bluffs to the east. Chief of the 200 factories are the paper mills making every kind known, foundry and machine shops, sanitary clay products and automobile accessories. Founded in 1838, incorporated in 1884. Pop. 1924 (city directory), 60,542.

LOCATED in glacial gravel of a terminal moraine in a comparatively flat basin and surrounded by rising ground on three sides, upon which residence districts outside the city limits are fast growing, Kalamazoo, Mich., with its commission-manager form of government and force-account way of making improvements would interest the engineer even though its cacophonous name and celery reputation had not long ago aroused his curiosity. Decidedly factory in type the city boasts of having so many different lines that stability is more than usually enjoyed by the diversity thereof. Paper mills, which gained headway when the town was young, the forests near and the now small water power of some consequence, rank first in importance, being twelve in number and employing 4,000 men. Every kind of paper is made and the largest single plant in the country, employing 1,000 men, is located here. Second in importance are the machine shops and foundries, then follow the makers of high grade clay products like sanitary wares, then automobile parts and taxicabs.

Of engineering significance is the easily obtained ground water supply with which the factories generally furnish themselves, the paper mills alone pumping 40 m.g.d. while the city only has a consumption of 12 m.g.d. Sewage disposal therefore becomes a heavy burden and is not to be measured in volume supplied by the municipal water-works.

The early city was settled on the west bank of the Kalamazoo River, which comes in from the southeast through the only low flat area contiguous to the city, makes a bend in the center of the city and flows directly north through a comparatively narrow valley. Although the railroads and the principal state highways come in from the diagonal points of the compass the street layout has held remarkably well to a north and south rectangular basis due, no doubt, to the flat topography of the square mile area in the original city.

Rock is never sought for foundations, the bearing power of the gravel usually encountered at the desirable basement depths being entirely sufficient for all building purposes. Trenching by machine is not practiced, mainly however, because most underground public utilities have been put in piecemeal which means many obstructions would be encountered. Further, the sandy top soil caves badly and requires sheeting either wet or dry. Groundwater in the flat downtown basin stands 6 to 8 ft. below the surface and is usually encountered at 20 to 30 ft. down on the hills, being held up by a thin stratum of clay. An abundance of sand and gravel, making good road material and concrete aggregates, is available within the city limits. In fact one gravel plant ships as far away as Illinois.

With all these natural advantages and its multiplicity of diversified manufacturing establishments, Kalamazoo has had a steady though not rapid growth—53,000 in 1920, 60,542 by the 1924 count. There are about 10,000 just outside of its boundaries that must soon be annexed. No annexing has been done for many years because of the legal obstacles. The county must vote to release the area in question which itself must vote favorably as well as the city to accept. Since Kalamazoo, is, so to speak, overflowing its boundaries on all sides, being now essentially a 2¾x3-mile rectangle, the city engineer has his hands full keeping subdivision streets lined up. Water is served *en bloc* to communities at an advanced price with the meter at the city limits and sewage goes to individual cesspools or septic tanks. The latter, through orders to the county, one of these days will be ordered abated by the state board of health and that will be the signal for the county to vote its constituency into the city and the suburbs to come in. Illinois has recently passed a law permitting cities having a plan to control subdivision plotting within 1½ miles of its boundaries and the city engineer wanted the writer to tell him all about it.

City Government—Kalamazoo has six elected commissioners and a mayor, who selects a manager who in turn selects his department heads. The city engineer is the director of the department of public works and by virtue of his office becomes chairman of the plumbers board and the moving picture operators. His department covers paving, sewers, sidewalks and bridges, building and electrical inspection. Garbage collection is under the health department which lets contract to pig feeders. Operation of the water-works, consisting of sixteen scattered wells, 125 to 200 ft. deep, is handled directly under the city manager, as director of public utilities, by a chief engineer.

The staff of the city engineer, Edward S. Clark, consists of a first assistant in charge of paving, bridges and sidewalks and a second in charge of general design, office and testing, each having the necessary assistants. The building and electrical inspection divisions each have men in charge. Since all work is force-account, each job is handled by a foreman under the direction of the engineers. Reports, on which labor and material costs to various items are segregated, are filed daily. Even truck drivers must file such reports which are trans-

ferred daily to payroll sheets sent to the auditor and to the city engineer's desk. Cross checking is required so that every item is accounted for and no chance exists for payroll padding.

Pending the construction of a new municipal building the offices are housed in old private residences on property the city has purchased just south of Bronson Park around which civic and county buildings are located. All officials except the engineers occupy a spacious residence, the rooms of which were so large that little change except installation of interconnecting doors was required. The city engineer's "residence" is a fairly large frame structure which was converted by utilizing the parlor for general office, the dining room for Mr. Clark's office and a sitting room opposite the parlor for a drafting room. Extra windows were provided in the bedrooms for additional drafting rooms. The rear rooms of the building are used for testing and storage.

Paving—Perhaps the most interesting single feature at Kalamazoo is the low cost of pavement; asphalt top, which is the most-used type, at 84c. to 87c. per sq.yd. It includes upkeep but to amortize the cost of the $32,000, 1,800-yd. per day asphalt plant at an early date the price charged the tax payer is 99c., which includes 2¼c. for maintenance for five years. The yardage laid for the last three years is as follows: 1923, 34,740 sq.yd.; 1924, 134,000 sq.yd., and in 1925, 92,000 sq.yd. In 1923 the lowest bid was $1.29 per sq.yd. In consequence, the department feels it is saving the taxpayers 30c. per sq.yd. and in about four years will have amortized the cost of the asphalt plant. Interest and overhead are charged in. The following are unit costs for 1924 and the 1925 costs will not be materially different:

Item	Cents per sq.yd.
Plant labor	12.23
Street labor	10.36
Hauling	5.87
Sand per yard	7.35
Stone per yard	4.65
Asphalt (AC) per yard	26.84
Dust per yard	7.45
Miscellaneous material	1.66
Closing plant	0.20
Power and light	0.84
Kerosene	0.20
Coal	0.44
Cement	0.06
Fuel oil	4.77
Total cost of asphalt top per sq.yd. laid	$2.92

The above costs are based on 1-in. binder and 1½-in. top and take into account the following losses: Sand loss is 32 per cent. It costs 90c. per cu.yd. The stone costs 76c. per ton and the loss is 18.37 per cent. Asphalt cement costs $23.40 per ton and the loss is 0.2 per cent. Dust costs $6.55 per ton and the loss is 0.8 per cent.

The total cost of asphalt paving including a 6-in. base of 1:3:6 concrete is $2.28. Kalamazoo citizens claim that they are getting this kind of paving at a lower cost than any other city in the state. Nearness to the source of material supplies, a 10-hr. day with non-union labor receiving a minimum of 55c. per hour and mechanics getting 60 to 85c. is partially accountable. Having well organized gangs, carefully supervised, helps. Hollanders predominate as the type and their natural frugality and industry undoubtedly help Mr. Clark keep his costs down.

Aside from the construction of sidewalks with a grade down to the bottom of the curb and with curbs turned back into the parkway just the same as driveways are built, the Kalamazoo design is not unusual. Integral curb and gutter have 6-in. top, 6-in. vertical face with 1-in. radius curves at top and bottom. The gutter is 18 in. wide and the drop in the 6-in. slab is ¾ in. from junction with pavement to base of the curb face. On streets with little or no longitudinal grade, the curb face varies from 2½ to 10 in.

Miscellaneous—Because of the high ground water and porous underground conditions all sanitary sewers must be laid with tight joints of oakum and cement. Kalamazoo has separate systems for sanitary sewage and storm water drainage. An interceptor has been built along one of the creeks in the city and others are planned to concentrate the flow downstream in the river valley since the time is fast coming when the State Board of Health will order the Kalamazoo River cleaned up. Studies have been made of types needed and sites available. Advice from consulting engineers has been received.

The city has been zoned which will tend to stabilize the future sewer, water and paving facilities required. The city engineer was called in to design a water supply for the municipal golf course, for draining and dredging a small creek in a park one side of which has been fitted up for a tourist camp. This is a pay camp with all facilities of light, water and gas plates to which transients only are welcomed, the charge being 25c. for the first two nights but thereafter, to discourage the "flivver hobo," the price is doubled.

General opinion as to Kalamazoo is that it is getting engineering efficiency into its administration in a marked degree which helps it in no small way to lay claim to being the manufacturing capital of southwest Michigan. Mr. Clark has been city engineer since 1921 but has worked for the city since 1910. Politics plays no part in Kalamazoo city business. The city manager names the city engineer and holds him responsible without interference just as the city engineer hires his division heads and asks for results without attempt to dictate who is to be put on the payroll. For these exceptional technical services, the city manager according to the annual report, draws $5,600 and city engineer $4,400 per year. Kalamazoo is lucky.

Paving Practice in Mobile, Ala.

When the city of Mobile, Ala., contemplates doing a certain job of paving, plans and estimates for storm sewers, paving and curbing are first made for the entire area under consideration. These plans and estimates are then submitted to the three city commissioners for authority to build. A date is set for hearing of any protests, and every property owner affected by the proposed improvement is sent, by registered mail, a printed copy of the ordinance outlining the job, which is called a "venture." The city engineer then advertises the project, the bonds are sold, the contract let and work begins. The 21st venture, involving a cost of $370,000, and 78,000 lin.ft. of storm sewers, 31,441 sq.yd. of cement concrete paving, 16,585 sq.yd. of bitulithic and 51,000 sq.yd. of asphaltic concrete, has recently been completed. The 22d venture has just been started. This will cost about $400,000, and includes the construction of 43,127 lin.ft. of storm drains, 23,482 sq.yd. of bitulithic paving, 35,460 sq.yd. of cement concrete and 29,696 sq.yd. of Alabama rock asphalt. The 23d venture to cost $600,000, is in course of preparation. Wright Smith is the city engineer of Mobile.

The Heat-Drying of Sludge at the Baltimore Sewage Works

Plant for Converting Sludge Into Fertilizer Shut Down After 6½ Years' Operation by Company Under Contract with City

By C. E. Keefer
Engineer of Sewage Disposal, Bureau of Sewers, Baltimore, Md.

ONE of the unique features of the sewage-works of Baltimore, Md., has been its heat-drying plant where the sewage sludge was subjected to heat-treatment in a rotary drier, and where it was prepared as a base for fertilizer. This was the first heat-drying plant in this country used to dry sewage sludge for commercial purposes. The first sludge was dried in May, 1916, and except for several months in 1921 the plant was kept in operation more or less continuously until January, 1923.

The plant consists of two heat driers, one of which was in operation for only a short period, conveyors, grinders, screens, etc. The air-dried sludge is carried up an incline by means of a conveyor, and falls into the heat drier, 6 ft. in diameter and 40 ft. long, constructed of boiler-plate. Adjoining the end into which the wet sludge is introduced is a hand-fired furnace, using soft coal. The other end, which is slightly lower than the inlet end, terminates at a dust box, where the dried sludge falls after leaving the drier. The interior is equipped with a number of stationary steel shelves. During the drying of the sludge, the drier is kept in continuous rotation. The shelves lift the sludge, cause it to drop through the hot air passing through the drier, and convey it to the dust box. After leaving the drier, the sludge is ground, and passes through two drum-type screens. The two most serious difficulties in the operation of the plant were the protection of that end of the drier nearest the furnace, which warped because of the intense heat, and the tendency of the sludge to collect in balls. This buckling of the drier was corrected by increasing the draft of air. The formation of the sludge in balls was guarded against by using care in feeding the material into the drier.

The operation of this plant falls into two periods: (1) Feb. 15, 1916, to Jan. 31, 1921; (2) July 21, 1921, to Jan. 31, 1923. During the first period the plant was operated by a private company under a contract. The contract contained the following stipulations: The city should deliver air-dried sludge to the contractor. The contractor should build a plant costing not less than $12,000. The contractor should pay 81c. per ton for the heat-dried sludge, containing approximately 15 per cent moisture, no payment to be made if the nitrogen as equivalent ammonia fell below an average of 2 per cent in any one month. The contractor should pay a rental fee of $250 per annum for the land occupied. The contract should run for five years, at the end of which period the city would acquire the title to the plant after a payment of 50 per cent of the total cost of the plant, but not to exceed $6,000.

The First Contract—Construction work on the plant was started in the early part of 1916 and completed at a cost of $15,293. It was operated for about eleven months at a net loss of $6,394. On April 19, 1917, the plant was destroyed by fire. Insurance totaling $9,250 was received. The operating and fire losses totaled $12,437. This did not include the yearly rental charge due the city of $250. During this period the total quantity of sludge, which was obtained after heat-drying it, amounted to 2,901 tons. The net loss per ton of heat-dried sludge was $2.23, exclusive of the fire loss, and $4.29 including the fire loss.

After the fire the plant was rebuilt at a cost of $13,038, and was operated almost continuously from August, 1917, to January, 1921. The following is a brief financial statement covering the operation of the plant for the period named:

Total sales 8,583.61 tons sludge		$96,789
Operating expenses, not including moneys paid or due the city	$87,561	
Moneys due the city: 6,767.16 tons of sludge at 81c.	5,481	
Rent: 4 years at $250	1,000	94,043
Net profit since the fire		$2,746

The above net profit does not include any charge for interest on the original investment or for depreciation. As the city had the right to buy the plant for $6,000, the profit would be changed to a loss of $4,292.

TABLE I—QUANTITY OF HEAT-DRIED SLUDGE AT BALTIMORE, MD., AMMONIA CONTENT AND UNIT PRICES OBTAINED

Month	Quantity of Wet Sludge Dried 68 Per Cent Moisture, Tons	Quantity of Sludge After Drying, Tons	Per Cent Moisture	Monthly Sales, Tons	Average Ammonia Content, Per Cent	Price Obtained per Unit of Ammonia, Max.	Min.
Aug. 1, 1921 to Dec. 31, 1921	428.2	166.100	17.51	110.140	1.879	$2.65	$2.65
1922							
January	414.6	164.849	19.51	195.804	1.99	3.00	2.50
February	474.6	184.602	17.73	94.602	2.00	3.00	3.00
March	577.8	219.402	15.73	304.402	2.015	3.50	2.50
April	232.8	97.579	23.64	92.579	2.00	3.50	3.00
May	848.1	328.998	17.51	228.199	2.013	3.50	2.50
June	686.2	268.446	18.21	228.446	2.034	3.225	3.00
July	745.1	269.848	11.64	234.848	1.914	3.35	3.00
August	603.9	213.275	9.39	250.274	1.972	3.75	3.225
September	741.6	270.179	12.17	338.179	1.944	3.50	3.225
October	551.1	202.319	12.84	227.319	1.952	3.50	3.225
November	598.9	234.258	18.19	164.259	2.079	3.60	3.50
December	.....	134.879	16.34	50.879	2.00	3.50	3.50
1923							
January	545.5	194.320	10.17	334.320	1.846	3.60	3.50
Feb. 1, 1923 to May 31, 1924	.....	.....	.....	94.400	2.00	3.50	3.50
Total	7,448.40	2,949.054		2,948.650			

For the period after the fire the net loss per ton of heat-dried sludge was $0.50, which is based on a total net loss of $4,292.

On the whole there was no difficulty in selling the heat-dried material, perhaps in part because Baltimore is one of the centers of the fertilizing industry. The sludge was sold to fertilizing companies who used it as a base for commercial fertilizer.

Operation Since June, 1921—The original contract terminated on Jan. 31, 1921. Previous to 1921 prices as high as $6.50 per ton per unit of ammonia were being gotten, whereas in 1921 this price had dropped as low as $2.50 per unit. As the price of ammonia was considerably less, and as the tankage company had suffered a total net loss of $16,978 in five years, it did not care to continue its contract, which it had the option of doing for another five-year period.

The city was forced to find some permanent means of disposing of the air-dried sludge. Several methods were considered, which included barging it to the Atlantic Ocean, spreading and piling it on the ground, and continuing the heat-drying process. A number of attempts were made to interest local fertilizing companies in the project, but with no success. The tankage company did not care to enter into another contract,

TABLE II—FINANCIAL STATEMENT OF HEAT-DRYING PLANT, BALTIMORE SEWAGE-WORKS

Month	Money Return from Sale of Sludge	Coal Used — Tons	Coal Used — Total Cost	Electrical Power	Labor	Repairs	Freight and Hauling	Miscellaneous	Administrative Expenses	Fixed Charges — Amortization	Fixed Charges — Interest	Net Operating Loss Exclusive of Fixed Charges	Net Deficit Including Fixed Charges
Aug. 1, 1921 to Dec. 31, 1921	$493.57	45.42	$194.25	$27.74	$552.13	$373.87	$255.07	$350.13	$796.05	$744.18	$220.42	$2,100.67	$3,065.27
1922													
January	1,145.02	57.25	411.51	165.19	639.74	138.79	397.66	192.47	258.80	252.02	70.99	1,059.14	1,382.15
February	567.62	60.10	202.12	63.49	247.70	104.11	234.75	104.63	235.00	249.05	69.78	624.18	943.01
March	1,797.14	68.00	711.04	177.14	774.28	362.52	632.75	98.58	282.55	249.05	68.49	1,241.72	1,559.26
April	617.41	26.70	179.11	65.10	216.00	813.28	194.29	75.44	235.00	249.05	67.25	1,160.81	1,477.11
May	1,326.47	76.00	332.71	104.17	416.91	156.94	571.19	130.46	235.00	249.05	65.99	620.91	935.95
June	1,484.53	66.95	338.58	98.42	428.67	40.23	440.32	164.03	285.00	249.05	64.75	310.72	624.52
July	1,454.08	40.00	333.14	113.08	469.60	266.56	480.70	164.42	235.00	249.05	63.50	608.42	920.97
August	1,689.34	50.50	269.36	142.46	491.88	272.76	563.35	119.36	235.00	249.05	62.26	404.83	716.14
September	2,176.82	95.40	800.24	308.58	926.64	453.72	630.38	250.65	235.00	249.05	61.02	1,428.31	1,738.38
October	1,481.48	45.75	544.46	186.29	552.45	511.15	344.49	124.56	285.00	249.05	59.77	1,066.92	1,375.74
November	1,228.58	103.05	468.03	128.91	399.23	21.45	339.43	163.00	235.00	249.05	58.53	526.47	834.05
December	356.15	45.00	190.95	40.77	130.25	118.67	225.38	105.97	215.00	249.05	57.28	670.84	977.17
1923													
January	2,209.71	45.90	975.07	314.07	1,077.33	92.91	580.36	183.12	215.00	249.05	56.03	1,228.15	1,533.23
Feb., 1923 to May 31, 1924	660.80	.....	187.16	57.63	238.77	435.24	292.36	685.45	736.00	.....	.....	1,971.81	1,971.81
Totals	$18,688.72	826.02	$6,137.73	$2,038.04	$7,561.58	$4,162.20	$6,182.40	$2,912.27	$4,718.40	$3,984.80	$1,046.06	$15,023.90	$20,054.76

and probably suffer additional losses. Finally, an agreement was entered into with the tankage company which embodied the following features:

1. The company should supply the necessary capital to put the reduction plant in good repair, and also the necessary capital of $2,000 to operate the plant for one month.
2. The company should supply all employees, furnish all tools, supplies, coal, etc., transport the sludge away from the sewage-works, and sell it at the highest market rates obtainable.
3. The city should deliver air-dried sludge to the reduction plant.
4. At the end of each month a balance should be taken, and the city should pay all losses for the operation of the plant. As part of the operating cost the company should receive, with interest at 6 per cent per annum, 1.66 per cent each month as an amortization charge on the value of the reduction plant, which was $6,000, and also on the money spent by the company in repairing the plant.
5. Should there be any profits, they should be applied each month in the following order: (a) Sufficient capital should be set aside to operate the plant, and pay for any repairs or renewals. (b) Profits should be applied to the payment of the advances made by the company under Section 1, to the payment of advances made by the city to cover losses in operation as provided in Section 4, and to pay the indebtedness of the company to the city of $3,483, with interest at 6 per cent. After the payment in full of the advances made by both parties, the profits should be equally divided.
6. The agreement should continue for 10 years with the understanding that either party could terminate it at the end of 5 years.
7. The company should operate under the supervision of a board of directors of 5 members, two of whom should be appointed by the mayor of Baltimore.

This agreement was executed in July, 1921, and the plant was put in good repair at a cost of $8,943. Furthermore, $2,000 was advanced by the company as a working capital in accordance with the agreement. It was not until January, 1922, that all of the repairs were completed, and the plant was operated to its full capacity. The operating force consisted of one superintendent, one fireman, and seven laborers.

The first few months of operation up until the end of March, 1922, were very discouraging. The monthly net operating loss, exclusive of amortization and interest charges, was $2.58 per ton of sludge (68 per cent moisture). Considerable difficulty was had with the drier, which began to warp and buckle because of the heat from the furnace. A number of methods were tried to correct this condition, such as lining the shell with fire brick. It was not until a considerable sum of money was spent that the trouble was fully corrected. Furthermore, during the winter months adverse weather conditions were prevalent. It was hoped, however, that during the summer conditions would be more favorable, and the net losses would not be appreciable. Unfortunately, the total net deficit for any one month during the whole period of operation never fell below $642. There seemed to be no satisfactory way to reduce this loss. It was suggested that the plant be operated on two shifts, in order to increase the output and lower the cost, but facilities were not available for the storing of the additional dried material. Moreover, the reduction plant dried only about one-third of the air-dried sludge, which accumulated to such an extent that the cost of dumping it increased.

Table I gives the quantity of sludge which was dried, its ammonia content, and its sale value per unit of ammonia. Table II is a financial statement giving the itemized cost of drying the sludge for each month together with the net loss.

For each pound of coal burned 4.9 lb. of water were evaporated, and 8.1 lb. of sludge (68 per cent moisture) were dried. The net cost of drying the wet sludge was $2.02 exclusive of the fixed charges and $2.69 including the fixed charges.

Disposal of Sludge to Farmers—During the latter part of the summer of 1922 it became clear that other means of disposing of the air-dried sludge would have to be adopted. Quantities of it had been given to the farmers in the vicinity of the sewage-works from time to time, but a great many farmers had objected to hauling the sludge for two reasons: (1) the roads at the sewage-works had been very bad; (2) they did not care to load their wagons and trucks. About this time the first objection was overcome by the building of several concrete roads at the sewage-works. The second objection remained to be met. A 3-ton locomotive crane was obtained for loading the trucks, and the demand for the sludge immediately increased. In 1922, 6,272 cu.yd. were hauled away. The cost to load the farmers' trucks was about 15 to 20c. per ton as compared with $2.69 a ton for heat drying it.

The financial losses of operating the drying plant began to increase again in the fall months; so the city officials finally decided that the most logical thing to do would be to discontinue the operation of the plant. Those persons who had originally financed the undertaking protested against this procedure. However, as the city was bearing all of the losses, and there

seemed to be no chance of ever making any profits, the plant was shut down in January 1923. After a delay of over a year, the reduction company agreed to release the city from its agreement upon the payment of all moneys which were due the company. A sum of $12,360, which included the amount unpaid on the plant, interest up to Oct. 1, 1924, unpaid bills, and which took into consideration certain sums the tankage company owed the city, was paid the company on Nov. 24, 1924.

The six and one-half years of experience which Baltimore has had with the heat-drying and marketing of the sludge has indicated that it is an expensive method to use in disposing of the sludge under conditions as they now exist at the Baltimore plant. The high cost was due in part to the excessive overhead expenses, and the cost of hauling the material to its point of destination. Furthermore, the air-dried sludge was not in the best of condition to dry as it often contained sand and gravel, which adhered to it when the sludge was removed from the sludge drying beds. Moreover, this inert material decreased the percentage of nitrogen in the final product. The quantity of nitrogen in the sludge is not sufficiently large to keep from having a net operating loss. The accounts indicate, however, that if the Baltimore sludge had contained about 4 per cent of nitrogen as available ammonia, the plant could possibly have been operated at a slight profit.

B. L. Crozier is chief engineer of the Department of Public Works. The sewage-works is under the supervision of M. J. Ruark, sewerage engineer. The writer is in charge of the designing and the operation of the sewage-works, and George H. Armeling is superintendent.

Air Mapping Under Frigid Conditions

Late in 1925 the U. S. Army Air Service undertook a photographic survey of part of the United States-Canadian boundary and the determination of the extent and levels of lakes extending northwest and northeast of Duluth, Minn., the territory covered taking in the western end of Lake Superior and scores of other lakes, including Rainy Lake, in a region devoid of landing fields and covered with thick forests surrounding the lakes. Special permission was granted by the Canadian government and much of the flying was over Canadian territory. Lieut. Eugene C. Batten, Air Service, home station, McCook Field, Dayton, Ohio, was pilot, in charge, and Edward G. Plank of the Corps of Engineers was photographer. The total time, from start from McCook Field to return there, was six weeks; the total distance flown was about 8,000 miles, and area covered 2,000 square miles. The airplane used was an amphibian, capable of landing equally well on land or water. About 720 photographs were taken with the new tri-lens camera and 300 with the oblique camera. Much of the mapping disclosed some regions of the country which had probably never been visited. During the greater portion of the time the temperature ranged between 10 and 27 degrees below zero, and ice formed on the wings and propeller of the airplane, which was out-of-doors the entire time. One morning after a storm the plane was completely covered with ice, which had to be chopped off. In summer when the lakes are open, this type of seaplane will be of great service in such surveys.

Railway Electrification Progress During 1925

Main-Line and Suburban Extensions—Traffic Conditions—Foreign Developments Motor-Generator Locomotives

IMPORTANT developments in the electrification of steam railways were made in 1925, although electrification made no great progress in relation to the mileage of the total railway system, since its advantages apply to local and special conditions rather than to railway operation in general. In addition to these limitations, the heavy expenditures involved are warranted only where very definite economy and improvement in operation can be demonstrated. With a railway system of 250,000 miles, barely 1,000 miles are electrically operated.

Notable among the developments of 1925 were: (1) the opening of the first 24-mile section of a 134-mile stretch of electrification on the Virginian Ry.; (2) the opening of the electrified lines of the Staten Island Rapid Transit Ry. (Baltimore & Ohio R.R.); (3) the rapid progress of work on the Illinois Central R.R. with a view to commencing electric operation of its Chicago suburban lines in 1926; (4) the placing of a contract for the electrification of a 24-mile section of the Great Northern Ry., crossing the Cascade Range; (5) the construction of electric locomotives of the motor-generator type for the Detroit, Toledo & Ironton R.R. and the New York, New Haven & Hartford R.R. Engines of the same type are to be used also on the Great Northern Ry. By far the longest stretch of electrically operated line continues to be that on the western section of the Chicago, Milwaukee & St. Paul Ry., 648 miles. For this railroad, transmission line current of 100,000 volts is delivered at substations where it is stepped down to 2,300 volts and converted to 3,000-volt direct current.

Virginian Ry.—The 134-mile stretch to be electrified (with 230 miles of track) extends from Roanoke to Mullens, but the 27-mile section, put in service in September, covers the 14-mile ruling grade between Elmore and Clark's Gap. Over this distance the maximum grade is 2.11 per cent, with a compensated grade of 1.98 per cent on curves. With steam operation, a 370-ton Mallet road locomotive of the 2:8–8:2 type and two 450-ton Mallet pusher engines of the 2:10–10:2 type are required to take a 5,500-ton train at about 6½ m.p.h. With electric operation, a 6,000-ton coal train is handled by two three-unit 642-ton electric locomotives, one at each end; each unit has a 2:4–4:2 wheel arrangement. These engines can accelerate in three minutes to the running speed of 14 m.p.h. From the yard at the top of this Clark's Gap grade, one electric locomotive can take a 9,000-ton train to Roanoke at about 28 m.p.h., or 14 m.p.h. on the heavier grades.

Trains of nearly 8,000 tons have been handled in this way for experimental purposes. Each three-unit engine is rated at 6,100 hp. and 7,125 hp. for 14 and 28 m.p.h. respectively, but can deliver 20,000 hp. in starting and accelerating. A transmission line from the company's power station delivers 88,000-volt current to substations delivering 11,000-volt current to the trolley wire, which is carried by a catenary suspension system. Owing to the length of trains and the numerous curves the two engines have a wireless system for communication by voice or by audible signals. The

power plant, transformer stations, transmission line and distribution system will be of capacity sufficient for handling an annual coal traffic of 12,500,000 tons, while twelve electric locomotives now under contract will be capable of handling 8,000,000 tons annually between Mullens and Roanoke.

Norfolk & Western Ry.—To facilitate further the handling of its coal traffic to tidewater, this road in 1925 extended its electrically operated section about 25 miles from Farm to Iaeger, on double track, with 53 miles of track. This gives a total route length of 56 miles from East Bluefield to a point west of Iaeger, W. Va., while the total track mileage is 209 miles, including main line first, second and third track, branch lines, sidings and yard tracks. Two two-unit engines, each of the 2:8:2–2:8:2 type, can handle 4,200-ton trains at 14 m.p.h. on long grades of 2 per cent having numerous curves.

Great Northern Ry.—Electric traction on a 3-mile section which includes the 2½-mile Cascade Tunnel has been in operation since 1909, but in 1925 the company decided to extend this over a 24-mile stretch from Skyhomish, Wash., to Cascade Tunnel station, at the east end of the tunnel. Instead of the present 6,600-volt system, the trolley wire will deliver 11,500-volt current to 340-ton locomotives of the motor-generator type, the 1,500-volt generator on the engine delivering 600-volt direct current to the motors. The present locomotives will be reconditioned for this new system. The line is to be put in operation before the end of 1926.

Each main locomotive will have a second unit supplied with current from the first. One such double unit will handle a 1,500-ton train at 14 m.p.h. on the long grades of 2.2 per cent, while two units will handle a 3,000-ton train. With steam operation, a 2:8:2 road locomotive and two 260-ton Mallet pushers (one being placed in the middle of the train) handle 2,500-ton trains at lower speed. Current will be supplied from a hydro-electric plant to be built by a power company at Lake Chelan.

Illinois Central R.R.—Electric operation of the Chicago suburban lines, with 37.4 route miles and 122.5 miles of track, is expected to be commenced in 1926, using multiple-unit trains taking 1,500-volt direct current from a catenary trolley line. A motor car and a trailer will be coupled together as semi-permanent units, and each regular train will consist of one to five such units. This important work is the first step in an extensive program for the complete electrification of the company's Chicago terminal system, including main-line passenger and freight service and local switching, as well as the suburban service. Current will be supplied from two commercial power stations.

In this connection, the Chicago, South Shore & South Bend Ry., an 80-mile interurban line whose trains enter Chicago over the Illinois Central R.R., will change from 6,600-volt alternating current to 1,500-volt direct current in order to conform to the system on the latter.

Detroit, Toledo & Ironton R.R.—For the operation of its 17-mile freight branch from Flat Rock, Mich., to Detroit (Fordson), with a total trackage of 42 miles electrically operated, this road designed and built the first locomotive of the motor-generator type, which has the unique feature of taking high-tension current of 11,000 or 22,000 volts from the trolley line and converting it to low-voltage direct current which is supplied to the motors. The complete 342-ton engine consists of two separable eight-axle units, the entire weight being carried by 32 driving wheels. An unusual feature of this installation is that the catenary wire which carries the trolley wire is attached to bridge structures built up of precast concrete units; these bridges are spaced 300 ft. apart. Locomotives of the same type have been built for the New York, New Haven & Hartford R.R., and this type will be used in the Cascade electrification of the Great Northern Ry.

Staten Island Rapid Transit Ry.—A portion of this local system of the Baltimore & Ohio Ry. was put into electrical operation in June, in order to comply with the New York state law requiring the electrification of railways in large cities. The length of line is 21½ miles, with 50 miles of double track. Multiple-unit trains of two to five cars take 600-volt direct current from a 150-lb. third-rail by means of top-running contact shoes. A transmission line from the power station of a local electric company delivers 33,000-volt current to substations which are equipped for automatic operation.

Other Railroads—The overhead-wire system of electrification on the New York, New Haven & Hartford R.R. has been extended over the Danbury branch, 24 miles, with 31 miles of track, thus avoiding the change from electric to steam locomotives at South Norwalk. This road and the New York, Westchester & Boston line have now a total of 197 route miles and 730 miles of track in electric operation. On the New York Central R.R., the third-rail 650-volt system was extended slightly, making 54 route miles and 271 miles of track electrically operated, with additional trackage to go into service early in 1926. Electric operation is to be applied to the company's freight lines on the west side of New York City, using the third-rail system down to 72nd St. and oil-electric locomotives further south. Electrification is in active progress on the Yonkers branch of the Putnam division, the Port Morris branch, and sidetracks at Yonkers and Mount Vernon, N. Y., involving an expenditure of about $5,000,000.

Extension of the New York terminal electrification of the Pennsylvania R.R. to Philadelphia has been predicted, and preliminary work is reported as started for electrification from Philadelphia to Wilmington. The Long Island R.R. extended the third-rail system of its multiple-unit suburban service from Jamaica to Babylon, 28 miles of double track, bringing the total to about 110 route miles with 297 miles of track. Further extension on the main line to Mineola, with the Oyster Bay and Hicksville branches, is said to be contemplated.

For the extensive stripping and open-cut coal mining operations on the Northern Pacific R.R. coal property at Colestrip, Mont., two of the largest storage-battery locomotives ever built have been put in service by Foley Brothers, who have the contract for this excavation and mining work (*Engineering News-Record*, Nov. 26, Dec. 10, 1925, pp. 867, 960). They are 70-ton engines, each with four 250-volt motors.

Foreign Railroads—On the Mexican Ry., the present electrification including the Maltrata grade is to be extended eastward 17 miles between Orizaba and Cordoba, where there is a long maximum grade of 3 per cent. In Brazil, the Paulista Ry. is extending its electrification from Tatu to Rio Claro, making a total route length of about 63 miles. In Chile, the Anglo-

Chilean Consolidated Nitrate Co. plans to electrify its line from Tocopilla to Central, 24 miles.

In England there has been a rather insistent popular demand for main-line electrification, as a means of improving train service. But the railway engineers point out that with the relatively easy grades and the lack of water power such a change would not effect the supposed results and the enormous expense would not be justified. On its London suburban system, the Southern Ry. has extended electrification considerably. The Netherlands State Rys. have introduced multiple-unit rapid-transit service, and in Java (a Dutch colony) some of the principal lines are being electrified. The Northern Ry. of Spain, which began operation of a 40-mile section in 1924, is proposing to extend the system between Barcelona and Vich, making a total of 115 miles. The French railways are carrying out extended programs of electrification. In Switzerland, the state railways expect to extend the system from the present 250 miles to 940 miles by the end of 1928. The Czecho-Slovakian State Rys. are electrifying 75 miles between Prague and Pilsen, using the 1,500-volt direct-current system. Extensions or initial installations are reported also as under way in Austria, Italy and Germany.

Main line electrification is in progress in South Africa, while electrification of suburban lines has been introduced at Melbourne and Sydney, Australia, and at Bombay, India. The Japanese Government Railways are gradually carrying out a program for the electrification of the busy main line from Tokio to Kobe, 375 miles, where grades of 2.2 per cent are encountered. It will apply this system also on the line from Tokio to Kofu, which has maximum grades of 2.5 per cent.

It will be seen, therefore, that although electrification is applicable only under special conditions and to a small proportion of the total railway mileage, it shows a steadily increasing activity.

Kittitas Reclamation Project Begun

With a view to immediate rapid construction of irrigation works for the Kittitas project, Yakima Valley, Washington, the Bureau of Reclamation has asked Congress for an additional appropriation of $2,000,000 for 1926 and 1927 to supplement the sum of $750,000 already requested. This is because the state of Washington has agreed to co-operate with the federal government as required by the 1924 act of Congress and has executed a contract to assume the cost of the settlement and development. Active work there is already in progress to secure rights-of-way for canals and other works, flowage rights, agreements to cross railway tracks, and the like. An appraisal board has begun appraisal of the lands to be purchased by the government. Engineers are to be transferred from other parts of the reclamation organization to Kittitas to take charge of actual construction work. Present irrigated land in the Yakima Valley includes 350,000 acres. Fruit represents half the total production in value, or $23,000,000 out of $47,000,000 total production of the irrigated lands in the valley during the year 1925. The new land to be irrigated is about 70,000 acres. The main canal will be 27 miles long to the Yakima River crossing; construction will probably be carried out at several points at the same time. Sufficient water storage is already available for use when the diversion dam and canal are constructed.

Economies in Laying Cast-Iron Water and Gas Mains in Omaha, Neb.

By H. V. Knouse
Construction Engineer, Omaha Metropolitan Utilities District

Abstract of a paper read before the Iowa Section of the American Water Works Association.

INSTALLATION of water and gas mains is a specialized class of work, requiring foremen and skilled labor not generally available in the labor market. Where it is possible to hold together the nucleus of a trained organization from year to year, it seems evident that cheaper and better work can be done by a force account system than where organizations are built up and down town, not merely from year to year but from month to month.

A factor greatly affecting the progress and cost of work is a careful planning of the order in which the various jobs shall be done. Moves of machines or gangs should be as short as possible; trench should be opened ready for the gang to begin work; pipe and specials should be on the ground, and the gang foreman should have complete maps in his hands when ready to begin work. Since ditching machines, backfillers and all other special machinery are operated as units separate from the pipe laying gang, and usually serve several gangs, it is necessary that they should be routed separately. In general, the plan of work is made with respect to the ability of the ditchers to open trench, and as many gangs as are necessary to keep up with the machine are routed behind the ditcher. Where backfillers, paving breakers, tampers, concrete mixers or other apparatus is necessary, it is ordered to the various jobs so as to keep these machines occupied as nearly as possible full time, and without delaying the other work.

All machines are operated as independent units both in dispatching and in accounting. Items of cost, including depreciation, operating labor, repair labor, repair parts, gasoline oil and supplies are accounted for and the cost per unit of work done is computed, to be used in figuring prices to be applied the following season.

Proper flushing or tamping of trenches must be done if settlement of paving is to be avoided, and the cost of refilling a trench in an unpaved street due to settlement after the construction gang has gone is always too high. In all possible cases backfilled material is thoroughly flushed, and for this purpose a pipe nozzle 5 ft. long is used on the flushing hose. By this means it has been possible to saturate all refill and to eliminate practically all pockets of dry material which might later settle and cause damage. On steep grades it has not only been found difficult to flush trenches properly, but washing out of material during heavy rains causes a large expense. By building timber bulkheads at intervals of from 50 to 200 ft. apart this trouble has been largely eliminated, and since these bulkheads may be made of second-hand flooring, shiplap or plank the expense is small.

Realizing that special training of all men in the division is necessary if best results are to be obtained, a foreman's school or conference was started about a year ago for the instruction of foremen and others who have supervisory charge of work. These schools are held Saturday afternoon from 2 to 4 p.m. and all foremen are required to attend. Matters are discussed relative to the work, information is given as to what progress has been made during the previous week, foremen describe any particular difficulty they have had in the course of their work and what measures were taken to meet it. A general training course is carried out. Among the subjects that have been discussed are: Safety work affecting workmen and the public; first aid, with particular reference to resuscitation from gas asphyxiation and from shock; procedure in case of an accident either to a workman or the public, such as obtaining names of witnesses and data pertaining to the manner in which the accident happened; attitude of employees toward the public to promote good will. One meeting was devoted to the proper shaping of cutting and calking tools, the proper size and shape of frost and concrete bars. As a result of this discussion standards were adopted which have not only simplified the work of the tool department but have caused much better and more uniform equipment to be sent to the men on the job.

Florida as an Engineer Sees It

A Series of Articles on the Human and the Engineering Significance of the Greatest Land Boom in the History of the Country

By Frank C. Wight
Editor, *Engineering News-Record*

III—Railroads and Ports

PERMANENT development of Florida depends upon the improvement of its transportation facilities. From its location the state is necessarily a terminus for rail lines and for coastal ocean traffic and the growth of its facilities has been slow on that account. The present boom found a demand for transportation, both freight and passenger, far greater than the supply. The past year has seen an intensive effort to make up the deficit. In consequence, more new railroad was built in Florida in 1925 than in any other state, and there is more activity in harbor work than on any comparable line of coast in the country. Plans for both railways and harbors, too, look forward to a period of less feverish growth when the demands of industry and agriculture will require ready transportation about the state.

Railways—The map of Florida, p. 245, shows coverage of the state by the three main-line railroads—the Seaboard Air Line, the Atlantic Coast Line, and the Florida East Coast Ry. There are some minor and subsidiary lines not shown and it will be noted, too, that the Southern Ry. enters from the north as far as Jacksonville and Palatka.

Of the three lines, the Seaboard, with only one entry into the state covers the northern and western part of the state and through its extension completed in 1925 enters the east coast on a new line from Coleman to West Palm Beach, a distance of 205 miles. The railway also has a western connection into the Panhandle toward Tallahassee and Pensacola. The Seaboard's lines projected or now under construction comprise a 35-mile extension of the Naples, Seaboard & Gulf Ry. from Fort Myers to Naples on the southeast coast and completion of a northwest coast line by the construction of a 22-mile connection between Inverness and Brooksville. It has also received the necessary certificate of convenience and necessity to construct a new line from West Palm Beach to Florida City through Miami. The latter line, a distance of 92 miles, taps the newly developing east coast hitherto monopolized by the Florida East Coast Ry. There is a great deal of discussion going on concerning this new route, the railway authorities demanding certain right-of-way concessions from the land owners, who in the present booming period of Florida real estate seem reluctant to make such concessions. Miami, which is now reached by rail only over the single track of the Florida East Coast, is naturally anxious to have the extension made and great agitation is going on in commercial circles there to urge landholders to give or sell cheap to the railway the right-of-way required. The matter today, however, is in *statu quo*.

The Atlantic Coast Line enters the state in two places—one in the center of the state and the other through Jacksonville—and covers generally the same part of the state as the Seaboard Air Line. It has extensions under way opening up the at present almost isolated Southern territory, notably the Sarasota-Fort Ogden Line of 39 miles on the west coast, a 27-mile extension south of Immokalee to Deep Lake and thence to Everglade, at the extreme southwestern end of the Everglades, and a 46-mile extension on the west coast from Fort Myers to Marco. In the northwestern section, the road has a 41-mile connection north of Perry to Monticello, and thence out of the state to Georgia. So far, the Atlantic Coast Line has not attempted to invade the east coast.

The Florida East Coast Ry., the famous line built by Flagler which really opened Florida to the tourist travel and brought about the present boom, was originally a single-track line from Jacksonville to Miami, and thence down over the Florida Keys, mostly by bridge, to Key West. It has since its original construction added a loop to Palatka and an additional east coast line back from the ocean from New Smyrna to Canal Point on Lake Okeechobee. It has a certificate from the Interstate Commerce Commission for the extension of this line from Canal Point to Miami, opening up the Everglades district between those two places. In addition, the East Coast Ry. has had under construction for a year and a half a double track over the full length of 366 miles from Jacksonville to Miami. About 200 miles of this double tracking has been completed, but not continuous and only short stretches are in operation.

Some other double tracking is under way by the other main roads, but most of the line in Florida is single tracks. Both the Seaboard and the Atlantic Coast Line, however, have a number of parallel lines which so far as operation is concerned serve practically the same purpose as double track.

Everywhere on the west coast will be heard rumors of an entirely new railroad combination entering somewhere from Georgia and Alabama and reaching down the hitherto undeveloped northwest coast. No confirmation can be had for any of these rumors, but responsible local people everywhere will tell you of rights-of-way secured and options sought for. Actual prospect of such a line has so far not manifested itself.

Construction Details—According to the statistics of the *Railway Age Gazette*, during 1925 there were built in Florida 99 miles of first track and 236 miles of second track, making a total of 335 miles, while in the United States for the whole year the first track built was 643 miles and the second track 682 miles.

In addition to the new construction under way, the Atlantic Coast Line has completed some extensive shops and yards at Uceta, near Tampa, and a new yard at Lakeland. The Florida East Coast has under construction an extension classification yard at Hialeah, just west of Miami, and has built a cutoff at St. Augustine, 29 miles long. It has, too, practically completed the new Bowden terminals just south of Jacksonville and shops at St. Augustine, and in the improvement of its main

line from Jacksonville to Miami is replacing a number of bridges. The Seaboard completed new yards and shops at Baldwin and Wildwood.

The neck of the bottle of the railway entering Florida is in and around Jacksonville. Up until quite recently practically all of the freight and passengers coming into the state had to pass through this neck and the congestion there is more than anything else responsible for the embargo which had to be placed last fall on all but perishable freight. This congestion will be relieved when the Atlantic Coast Line completes its bypass between Jacksonville and Yukon to the south, when the new East Coast yards at Bowden are completed, and when the Atlantic Coast Line has a new entry to the state via Monticello. A year from now the prospects of traffic relief should be very good, but with the continued demands for construction materials and other supplies which the increased population of Florida has brought about, little relief can be looked for much before that time.

At present both freight and passenger travel in Florida is very slow. There is a tendency to criticise the railway management for delays, but the conditions which the railways have had to meet have been almost unprecedented, except in the congested periods of the War. Punctuality on the far southern railways seems often to be an unknown virtue, and the railway operators have become so accustomed to trains being late that no one is particularly concerned when they are late. The question always is not whether the train is late but how much it is late. There is little doubt that this is a state of mind and that such a state of mind governs operations to a considerable extent. Were it possible to bring down to Florida a group of operators of a large terminal in one of our northern metropolitan centers together with the entire personnel of such a railroad, in all probability considerable improvement in punctuality would be noticed. As it is, every one expects trains to be late and no one worries particularly when they are. Nevertheless, the Florida East Coast Ry., for instance, is running 60 trains a day over its one-track line south of Jacksonville and the wonder may be that it gets them through at all, not that it gets them through on time.

There is a criticism in Florida, too, of the Florida East Coast's slow progress in the double tracking of its through line. Certainly, a trip along that line does not indicate any feverish activity in the building of the second track. As one engineer commented who looked at the work, if there happened to be a war in Cuba, the Florida East Coast's second track would have been in six months ago. There are no tremendous construction difficulties to be overcome. The criterion of construction speed apparently is the amount of money which the road cares to spend in a given time. Meanwhile, the Seaboard with its entry into Palm Beach has taken a considerable amount of the passenger business away from the East Coast and if it continues to Miami will doubtless tap there an equally lucrative territory.

Railway construction in Florida is a fairly simple process. There are few hills and such hills as there are are readily reduced with the steam shovel. There are numerous water courses to be crossed and many of them are navigable which, with the low grades on which the roads run, require drawbridges. Track construction, however, is fairly simple and the local lime rock crushed is the typical ballast.

Developing Ports—The great demand for material and commodities in Florida, coupled with the rail embargo and the proximity of the ocean to so many of the booming towns and cities, has aroused a general urge for harbor development. There are only four real ports in the state, Jacksonville, Key West, Tampa and Pensacola, but Jacksonville is itself the heart of the congested area so its use has been limited and Pensacola is too far west and Key West too far south to be of much use in the current crisis. Tampa serves well the lower west coast but is of no value to the rest of the state. Consequently many of the smaller communities, on the gulf or ocean or on waterways connecting thereto, are having dreams of port greatness. Anything in the way of a port looks hopeful and the coast of Florida lends itself readily to the design of ports.

Jacksonville is the major port of the state. It is on the St. Johns River about 28 miles above the entrance and the harbor extends 2 miles above and 2 miles below the center of the city. There is a 30-ft. channel to extensive and modern terminals at the city, part municipal and part commercial development. The facilities available are capable of taking care of the business that is offered. While the port of Jacksonville has benefited by the increase in business in Florida, the city is so far north and the rail communication south of it so congested that the lack of proper transportation in the central part of the state is not being alleviated very much by the excellent port conditions there.

Tampa, the major west coast port, is on a bay affording an excellent natural harbor. A 25-ft. channel is maintained and the government project calls for 27 ft. About 95 per cent of the 27-ft. project is complete. There are at Tampa 14 wharves of combined freight and passenger type and of both private and municipal ownership. They are well served both by roads and railroads. Tampa is getting a great deal of the increased transportation business through its port, the opportunity being taken to ship by rail to the gulf ports of New Orleans, Pensacola, Galveston, etc., and send by ship across the gulf. It serves a considerable part of the west coast area, but the rail conditions are not such as to permit shipment across the state to the east coast with any degree of facility.

Key West is the last of the major harbors. The project here is for 30-ft. depth in the main channel with minor channels of lesser depth, all reaching the 10 wharves and piers which are connected to the city streets and two of them by rail. No additional work is going on in the Key West harbor, although the project is being maintained. Some freight is being shipped there to be transported north over the Florida East Coast Ry., but not enough to cause any tremendous congestion in the port.

Miami's Port—Miami has a special port problem of its own. The city lies on Biscayne Bay, a shallow inlet varying from 3 to 9 miles wide, bordered on the east by the sand spit which has been made into Miami Beach. The channel has been dredged between two of the littoral islands across the 4-mile width of the bay to the city. This channel has a usable depth of 17 ft. It is guarded at its entrance with twin jetties and it parallels for its whole distance the original causeway connecting Miami to Miami Beach, which causeway for a large distance is built of fill taken from the dredged channel. The channel leads to a very limited dockage

space immediately alongside the busiest part of Miami. Connection to this dockage space has to be made by motors on streets through the business section and crossing the Bayshore Drive, one of the most crowded of the city's boulevards. More than that, rail connections are through two spurs from the Florida East Coast Ry. running on grade across this same boulevard onto the dock.

Since the rail embargo pretty effectually shuts Miami off from the north, great demand has been made on its port facilities. Large passenger steamers of the ocean

PRESENT RAILWAYS OF FLORIDA AND LINES UNDER CONSTRUCTION

The Seaboard Air Line enters the state in the northwest, covers the northern and western part and enters the east coast at West Palm Beach. The Atlantic Coast Line has two points of entry at the north and covers the western and central parts—but does not reach the east coast. The most congested line is the Florida East Coast Ry., due to its route through the Atlantic coast section where the land boom most flourishes.

type were immediately put on from the northern port, but as these practically all drew more than the 17 ft. of water permitted they had to anchor off the shore and the passengers had to be lightered in. The regular and lighter draft coastwise steamers docked at their own wharves, but the great number of tramp freighters and sailing vessels which were put into service last fall have had to wait for days and weeks at times off shore for an opportunity to get into the harbor and up to the limited dock space. A few weeks ago one of these ships sank in the harbor entrance and effectually blocked the channel for a long period.

Last year agitation for a new harbor became very great in Miami and a scheme proposed by a local committee was adopted by the city government. Col. F. W. Altstaetter, of the Corps of Engineers, retired, has been retained by the city as harbor engineer to carry on this work. The city has advanced to the federal government a sum sufficient to permit the government to start immediately on the dredging of a 25-ft. channel under the project which was authorized by the last Congress but appropriation for which will not be available until next July.

The city's plan for improvement has not been completely formulated, but in general it is proposed to build a new island in Biscayne Bay to the south of the present causeway and to make in that island slips from the present channel to be dredged to a 25-ft. depth and to erect on the island warehouses and pier sheds. The terminal island would further be connected to the present city docks and to the city proper probably in the future, by some overhead crossings which would avoid the obvious congestion of the bay front boulevard that would result if entrance to the new dock space was made on grade. It is not proper to criticize the design of this new development until its full details have been announced, but on the surface it appears regrettable that the city of Miami found it necessary to design a new and major terminal development at a place which requires entrance and exit through the city's busiest section. New York's so far vain efforts to separate its ocean traffic from its city traffic should be a warning to Miami.

Minor Ports—In addition to the ports mentioned, there are a number of the minor ports which are active. The federal government has not so far been persuaded that it is desirable to put money into any of these proposals, but permission has been given by the government to the local interests, mainly the municipalities, to go ahead with certain proposed schemes. In fact, the developments are indicative of the state of mind in Florida today, that the local people are willing to spend their own money to develop a port even in the matter of dredging, which has been contrary to the attitude of most of our ocean cities. Most coast towns have been well educated to the fact that the federal government does all the channel development work. In Florida, however, they cannot wait for the slow processes of economic growth to operate.

Notable instances of these minor ports are Palm Beach, where a bond issue of over $3,000,000 has been voted to deepen the inlet of Lake Worth to 24 ft. when the present 18-ft. project there is completed and to build dock, terminals and warehouses at West Palm Beach; the Ft. Pierce and the Stuart developments on the St. Luce River where 18-ft. channels are to be excavated, and the proposal at Sarasota, on the west coast, for a 22-ft. channel with turning basins and new islands in the bay to be paid for, according to the proposition not yet completed, by leasing the islands to certain public utility companies. There is, too, the entirely new development at Hollywood, where a permit has been given by the government for the development of what they call there a $15,000,000 harbor that has had a considerable amount of advertising due to the fact that General Goethals has been acting as consulting engineer for it. Here an opening is to be dredged through the littoral island, jetties placed at the mouth of the opening, and a harbor dredged in Lake Mabel to a depth of 30 ft. There is nothing at Hollywood today which warrants such a harbor. It is a flat sand waste on which in three years has been built a small city, consisting of hotels, golf courses and some resi-

dences. The project for the harbor contemplates, however, a large future industrial development. St. Petersburg, on the west coast, has recently improved its municipal port by construction of a new municipal dock. There is a 19-ft. channel here up to piers on the water front in front of the best part of the city.

Canals and Buses—Some of the new Florida traffic is being carried by canals, but not very much. There is a waterway, the Florida East Coast Canal, extending from Jacksonville to Miami. Theoretically it has a 6-ft. depth; practically it is useless for through travel and only usable to the lightest draft craft for short distances. Recently it has been sold by its private owner to another company which has announced that it purposes to dredge it to its designed depth and to operate upon it a fleet of barges. No one need be surprised, however, to see starting soon an unexplained propaganda looking toward the taking over of the canal by the United States.

Several of the rivers of Florida are navigable, notably the St. Johns, and some freight is being carried this way. The drainage canals which form the outlet to the Everglades drainage system, leading from Lake Okeechobee to the Atlantic, while not primarily designed for navigation are used for freight to a limited extent.

Finally, the railroads are being supplemented by motor trucks and buses. As was noted in the article in the issue of Jan. 7, the state and the counties are in the midst of an extensive road building program. The roads they are building are excellent and have naturally stimulated not only private but commercial travel. There are numerous trucking concerns operating regularly over the main arteries and the bus is everywhere. These buses are as a rule of the latest and most luxurious type. They run on schedules which—appealing as a novelty in Florida transportation—they stick to. But they do run fast, and after a few miles of riding near the front and (mentally) driving the bus at, in and around the minor traffic without perceptible effect on the bus itself, the only recourse for a nervous man is to sit sideways, look at the passing Florida landscape and trust to Providence that the constant horn tooting is not a forerunner of the apparently inevitable collision. So far as statistics go the buses are safe to ride in but, at the speed they are driven, they are not conducive to peace of mind.

Free Legal Service for Members of A.A.E.

Simple problems of engineering law are to be handled free to members of the American Association of Engineers by the plan under way by its committee on engineering law. The committee is headed by William Boone Douglass and has the advice and assistance of Morris Bien, past president of the association. Where the problem is complicated and expensive research is involved, a reasonable charge is to be made to cover the cost in order that the legal service bureau, as it will be called, may ultimately be self-sustaining. The guiding purpose is to keep engineers out of lawsuits. Pending a formal announcement, members are invited to submit their legal problems to the engineering law committee which now functions in making a monthly digest of current court decisions of interest to engineers. Recently it co-operated with the governor and state code commissioner of Arizona in revision and recodification of the Arizona laws.

Effect of Manipulation on Strength of Field Concrete

Tests Show That Concrete of Constant Visible Quality Varies According to Amount of Work Given Placing

By G. W. Hutchinson
Formerly Testing Engineer, North Carolina Highway Department

DESPITE the fact that either poor service or failure of concrete structures is always recorded under field conditions, investigations as to quality, etc., have been confined mostly to the laboratory. Laboratory investigations are necessary to determine theory and the effect of a given variable on the desired quality of concrete with other factors under control, but the true value of theory and the effect of the additional factors encountered in practical concrete must be determined from the results of field investigations.

One of the most important factors influencing the strength and uniformity of field concrete, and one upon which the effect cannot be determined in the laboratory, is that of manipulation. Regardless of the amount of science employed to proportion the aggregate, the effect of manipulation is sufficient to destroy entirely the economy of such procedure. The amount of handling given freshly mixed concrete practically determines the extent of segregation of the aggregate. Wet consistencies segregate much faster than dry ones when subjected to the same amount of manipulation. The mixtures which segregate least are not sufficiently plastic to place properly, unless workability is built into the mass.

TABLE I—EFFECT OF MANIPULATION ON STRENGTH OF FIELD CONCRETE

	Comp. Strength—Lb. per Sq.In. 1	2	3	4	Average
1:1½:3A*	3,403	2,210	3,384	3,851	3,462
1:2:4A	2,881	3,071	3,308	3,370	3,156
1:2½:5A	1,653	1,875	1,909	2,214	1,913
Average	2,646	2,719	2,867	3,145	2,844
1:1½:3B†	3,203	3,323	2,710	4,174	3,603
1:2:4B	2,673	3,034	3,207	3,392	3,077
1:2½:5B	2,211	2,375	2,333	2,467	2,347
Average	2,696	2,911	3,083	3,344	3,009
Grand average	2,673	2,815	2,875	3,245	2,926

*A denotes cores drilled from single batch.
†B denotes cores drilled from successive batches.

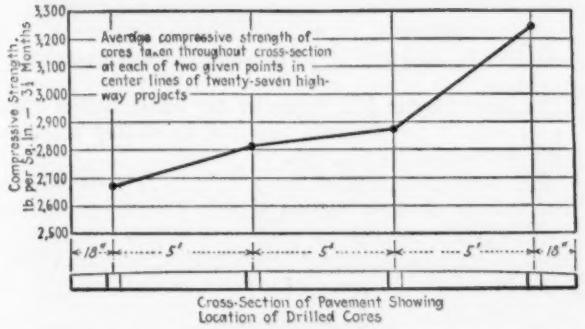
Workability and consistency are distinctly different properties of concrete, although considered by many as the same. The consistency of concrete is regulated by the water content, while workability is an intrinsic property governed by the character and amount of the various solids composing the mass. A 1:3:6 concrete may have the same consistency as a 1:1:2, but it is well recognized that the latter is much easier handled. Mixtures of the same proportions and water contents but with different types of fine or coarse aggregates will vary considerably in regard to the ease with which they are placed. Excess water makes wetter consistencies and produces segregation of the cement and aggregate. Beyond this point the deleterious effect of adding reasonable amounts of water in normal field mixtures has yet to be proved. Water may be used as a relative measure of the amount of cement and graduation of aggregate in the mix, but in practice an attempt is made to control such factors by specifications.

An example of the effect of manipulation of freshly mixed concrete on the variation in compressive strength

is given in the table. The tests constitute one of the field investigations carried on by the writer while connected with the North Carolina State Highway Commission.

The tests were made to determine the variation in compressive strength of pavement slabs subjected to various amounts of manipulation during placement. It compares the variation in compressive strength at the edges of the pavement, where practically the concrete is placed or worked by hand, with that in the middle thirds where it is dumped directly with but little further manipulation or handling. Excess of concrete in the central part of the pavement is generally manipulated to form the concrete at the edges.

The investigation consisted of a series of four cores taken throughout the slab at a given point at right angles to the center line of the pavement. Two series of such cores were drilled from 27 different highway



CURVE SHOWING THE EFFECT OF MANIPULATION ON COMPRESSIVE STRENGTH OF FIELD CONCRETE

projects. One core was drilled at a point 18 in. from each edge and one from each middle third. No two projects operated with the same combination of given materials. There were also the usual variables in proportions of mixtures, type of mixers, placing crews, etc., encountered in such a number of projects.

The detail of the investigation was divided in two parts. The first part, consisting of one series of cores from each project, was drilled from a single batch of concrete spread across the complete width of pavement. The second series was drilled at an arbitrary station where the concrete had been placed by the usual practice with no regard to the number of batches included by the cores.

No attempt has been made to analyze the results of this investigation beyond the effect of manipulation on the strength of concrete. By both methods of investigation there is but 3 per cent variation between the average strength of the edge cores and those from the center. When variation from the average is considered, however, the tests show an average variation of about 20 per cent at the edges, and but about 5 per cent in the center. An analysis of separate projects indicates this variation to be from approximately zero as the minimum, to over 160 per cent as the maximum. The mean variation of the edge concrete, as represented by the tests, is nearly four times that in the center portions of the pavement.

An investigation of this nature indicates the ununiformity and segregation in a concrete which appears to the eye as being dense and uniform in structure. It does not include the effect of the extreme state of segregation such as honeycombing. It represents tests of the type of structure in which the required amount of manipulation is the minimum. It has to do with the result secured by the so-called acceptable methods of placing the concrete pavement in a manner generally specified as "of suitable consistency, spread uniformly, etc."

With these results in mind it seems logical that the most important factor to be considered in placing field concrete is workability. By building this property into the mass it can flow into place with a minimum of manipulation.

Comprehensive Zoning Ordinance Adopted by Buffalo, N. Y.

BUFFALO, N. Y., is divided into six classes of use districts, four classes of height districts and four classes of area districts by the zoning ordinance adopted by the Commission-Council on Dec. 23 as an amendment to the city charter (printed with map in the *City Record* of Buffalo for Dec. 28). The use districts are residence, apartment-hotel, business, and first, second and third class industrial. The height districts (in terms of street widths) are known as ½, 1¼, 1½ and 1¾ "times" districts. The area districts, A, B, C, D, limit the portion of the lot areas that may be built upon and must not exceed 90-100, 55-65, 40-50, 25-30 per cent, the first figure applying to interior and the second to corner lots. In class A (90-100 per cent) the limit applies to the sill level of the second story windows and in A, B and C to the curb level in residence and the sill level of second story windows in all other districts, the higher level in all four cases to be not more than 25 ft. above the curb.

"Vision clearance" restrictions applying to fence, walls, shrubs, etc., at street corners are a feature of the ordinance.

Another notable provision is a possible lessening of some of the restrictions, after public notice and a hearing, whenever the owners of any tract of land not less than two acres in area submit a plan for a residential development, and a lessening or elimination of rear-yard requirements when recreational areas are dedicated in perpetuity to the use of residents of the plot, provided such recreational areas are at least 10 per cent of the area of the entire tract, 40 ft. or more in least dimension and with a total area of 10,000 sq.ft.; also, there may be a lessening or entire waiving of side-yard requirements provided there be "unimpeded access" to such a recreational area.

The administration of the zoning ordinance is vested in the city building commissioner, who has sole power to grant permits and is required to refuse permits in violation of the ordinance. Appeal from the decisions of this official may be taken before a Board of Appeals, consisting of city officers, acting ex-officio: chief of fire department; health commissioner; chairman, board of assessors, city engineer; executive and engineer, city planning committee.

Population of Japan Now 60,000,000

The population of Japan, as shown by the national census of Oct. 1, was 59,736,704, a gain of 3,773,651 in five years. The population of Osaka on Oct. 1 was 2,114,809 and of Tokio, 1,995,303.

From Job and Office

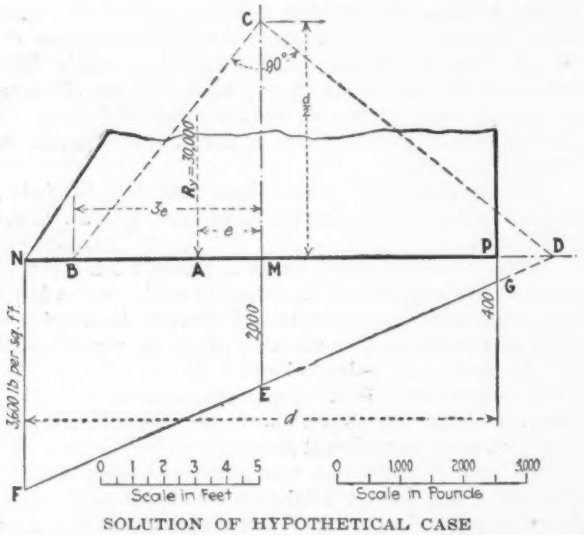
Hints That Cut Cost and Time For the Contractor and the Engineer

Graphical Construction of Stress Distribution Diagram

By Joseph A. Wise

Lieutenant (Junior Grade) C. E. C., U. S. Navy, Bremerton, Wash.

IN THE design of retaining walls, footings and other structures, where a linear law of stress distribution exists or is assumed, the following graphical construction will enable the distribution of stress or pressure due to eccentric loading to be determined quickly and easily. In the figure, a wall is shown, having a resultant pressure (vertical component) of 30,000 lb. The resultant cuts the base A at a distance $e = 2$ ft. from the center of the base. The point E of the pressure distribution diagram is found by laying off the average intensity of pressure, which is equal to the vertical component of pressure divided by the area of the base, vertically downward from the center of the base. In our case, assuming that we are dealing with



SOLUTION OF HYPOTHETICAL CASE

a unit length of wall, and that the base is 15 ft. wide, the average intensity of pressure is 2,000 lb. per square foot. The rest of the diagram is found by applying the well known formula,

$$p = \frac{P}{A} + \frac{6M}{bd^2}$$

The term P/A represents the average intensity of pressure already found, and the second term may be found by calculation or by the method now to be described. Lay off a distance $3e$ from the center of the base in the same direction as e. Lay off $d/2$ vertically from the center of the base to point C. At C draw a line CD perpendicular to BC and intersecting the base prolonged at D. Draw DE prolonging it to F, vertically below the outer edge of base. Then the required diagram to scale will be $FEGPMN$.

The proof for this construction is readily derived. Triangles BCM and MCD are similar, therefore

$$\frac{BM}{CM} = \frac{CM}{MD} \text{ or } MD = \frac{CM^2}{BM} = \frac{d^2}{12e} \quad (1)$$

From similar triangles NFD and MED, we get

$$\frac{NF}{ND} = \frac{ME}{MD} \text{ or } NF = \frac{ND}{MD} \cdot ME = \frac{d}{2}\frac{ME}{MD} + ME$$

Therefore,

$$NF - ME = \frac{6M}{bd^2} = \frac{d}{2MD} \cdot ME \quad (2)$$

M the moment of the eccentric force is $R_v \cdot e = ME \cdot d \cdot e$. Substituting this in Eq. (2) and solving for MD,

$$MD = \frac{bd^2ME}{12 \cdot d \cdot e \cdot ME} = \frac{d^2}{12e} \text{ since } b \text{ in this case is unity.}$$

Thus the distance MD given by our construction (Eq. 1) is exactly the distance required to satisfy the conditions imposed by Eq. (2).

The interpretation of the result if D falls within the base is obvious If no tensile resistance can be assumed, this method is no longer valid, although it could be covered by some additional construction. This latter is not simple enough for practical use.

Difficulties in Pulling Tongue-and-Groove Sheetpiling

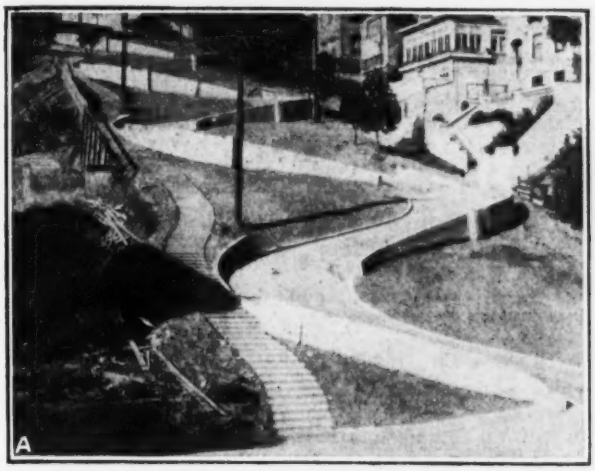
REMOVAL of part of a tongue-and-groove sheetpiling cofferdam used for constructing a sewer outlet into the East River at Brooklyn, N. Y., caused the contractor considerable difficulty. It was only necessary to remove the front side of the cofferdam, but the whole structure was wedged so tightly together that several methods had to be tried before the first pile could be removed.

The piling consisted of 10x12-in. piles about 40 ft. long grooved on both sides for the insertion of a loose tongue. The direct pull of the drop line of a crane exerting about 26 tons was tried first without any results. An old ship mast about 40 ft. long was then rigged up to pull the corner pile on the front row. One end of this mast was given bearing on the corner of the cofferdam and fastened about a foot above this end with a cable to the pile that was to be pulled. The drop line of the crane with a five-reeved block was then fastened to the opposite end of this 40-ft. mast. A pull of approximately 100,000 lb. was thus placed upon the pile, but after several attempts the mast broke.

The method finally successful was to invert a 2,900-lb. steam pile hammer, fasten it to the top of the pile, then to pull and jar the pile loose. After 8 hr. of continuous operation, the pile finally moved ¼ in. In the next 15 min. another ¼ in. raise was effected, after which the pile was pulled with no difficulty. The steam pressure used on the hammer was 50 lb. per sq.in.

The contractor on this work, the Hamilton Ave. sewer being constructed by the Brooklyn Bureau of Sewers, Arthur J. Griffin, chief engineer, was the Necaro Co., Inc., Brooklyn, N. Y.

How San Francisco Solves Steep-Grade Street Problems

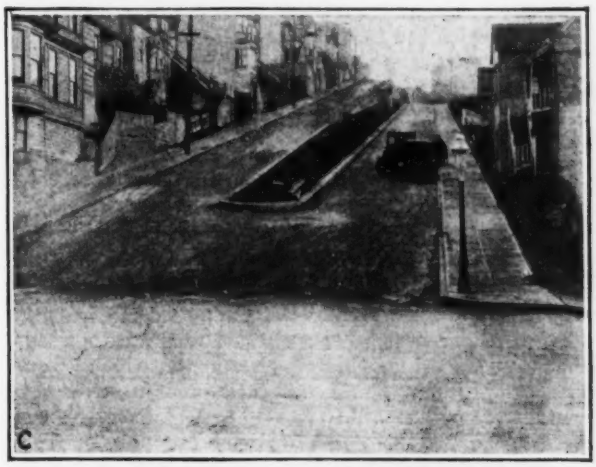


WINDING BRICK PAVEMENT ON LOMBARD ST. HILL

Original grade in this block was 26 per cent. The winding road is on a 19 per cent grade with a tangent width of 15 ft. The retaining walls are to check cars that may get out of control.

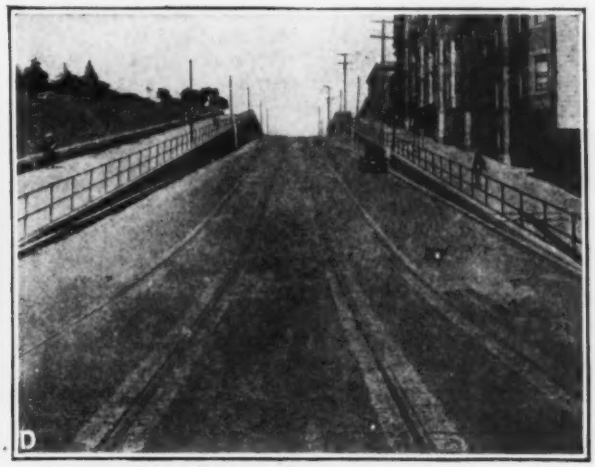
TWO-STRIP PAVEMENT FAVORS LOTS ON SIDE HILL

The two 18-ft. concrete strips on Caine Ave. are separated by a 12-ft. central parking strip and meet in a half circle or "turnaround" at the upper end. The grade on the upper strip is 15.9 per cent and on the lower strip 13 per cent.



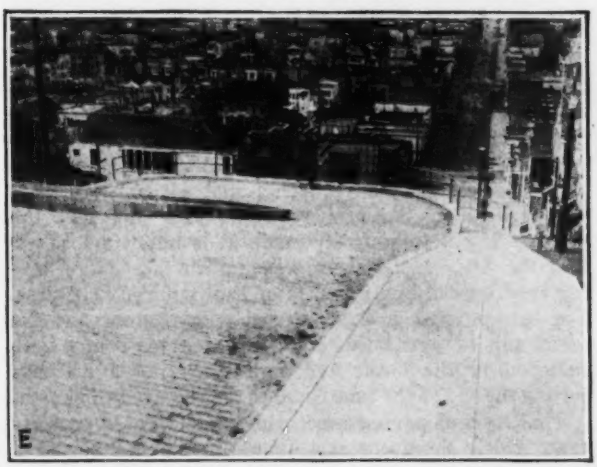
TWO-STRIP PAVEMENT ON LIBERTY STREET

These strips have too great a grade difference to join at the top and also a retaining wall is required between them. The grade on the upper strip is 19.14 per cent and on the lower 16 per cent. Width between property lines is 64 ft.



ROADWAY AND SIDEWALKS ON DIFFERENT GRADES

Hayes St. at Pierce has a car line and the track grade was kept down to 10.9 per cent without disturbing sidewalk grades by the expedient shown. Stairs lead from the street to sidewalks at convenient points.



NO THOROUGHFARE ON THE SANCHEZ ST. HILL

A through grade would have been too steep to be practicable here so the roadway was doubled back and a stairway gives pedestrians access to the street below.

SAME POINT FROM BELOW ON SANCHEZ ST.

The design was laid out to give a pleasing appearance and convenient arrangement of stairways without involving unnecessary retaining wall costs.

Economic Design of Pipe Lines

By J. W. Ledoux
Consulting Engineer, Philadelphia, Pa.

THE economical design of pipe lines has often been considered by nearly every engineer who has had much to do with water-works systems, either pumping or gravity. Many elements affect the problem, such as population, industries, future growth and finances, with which judgment and vision have more weight than applied mathematics. Now and then there is a case in which some of the essential elements can be known or assumed, such as the quantity of water, the static head, the percentage of allowance for fixed charges, the cost of pumping, the length and kind of pipe to be used and the coefficient of friction. With these known or assumed, the economical design becomes a matter of mathematical treatment. The object of this paper is to deduce the formulas for gravity and pumping mains in such manner that they can be readily applied by any one able to handle elementary mathematics. The following terms will be used:

d = diameter of pipe in inches.
H = static head in feet.
Q = discharge in million gallons per 24 hours.
q = discharge in cubic feet per second.
l = length of pipe in feet.
w = weight of pipe in pounds per lineal foot.
S = working tensile strength of pipe in pounds per square foot, from 2,000 to 20,000 lb. per sq.in.
k = the coefficient of pipe in Chezy's formula, from 100 to 130.
F = total frictional head in feet.
f = frictional head per foot of length in feet.
g = weight of pipe in pounds per cubic inch.
o = price of pipe in cents per pound.
n = per cent for annual cost of interest, depreciation, taxes, insurance and repairs.
m = dollars per 1 m.g. pumped 1 ft. high, measured in fuel.
i = cents per kw.-hr. as value of water energy delivered at power station end of pipe.
C = annual fixed charges plus annual value of energy due to friction (dollars) per foot of length.
C_1 = annual fixed charges plus cost of fuel due to friction measured in dollars per length, l.

For a gravity line the annual cost per foot in dollars can be expressed as follows:

$$C_1 = \frac{won}{10{,}000} + 7.42\,ifq$$

By substituting and equating the first derivative of C with respect to d to zero for minimum annual cost per foot we obtain:

$$d = \frac{a}{H^{1/n}},$$

in which

$$a = 32.27\left(\frac{q^2iS}{Ognk^2}\right)^{1/n}.$$

From this it is seen that the diameter of the pipe varies as the seventh root of the static head; and when the terms represented by a are arrived at the diameter corresponding to heads, H, can readily be calculated, and the pipe thickness calculated to resist the static head, with due allowance for water hammer, and if desired, corrosion.

From Job and Office

For Contractor and Engineer

For the pumping main, the problem is not by any means so simple. The annual cost can be expressed as follows:

$$C = \frac{wonl}{10{,}000} + 365QmF.$$

By substitution and equating the first derivative of C with respect to d to zero for minimum annual cost in dollars, we obtain:

$$l = \frac{k^2gonHd^7 - 4{,}290{,}500{,}000{,}000\ Q^2mS}{5{,}722{,}000\ gonQ^2d^2}$$

By assigning values to the lettered terms we get:

$$l = \frac{d^7 + a}{bd^2}$$

in which a and b are constants.

If d and l are tabulated and plotted, the curve will be found so nearly a straight line that intermediate values are readily interpolated. For instance take

$k = 100$ $g = 0.280$ $c = 5$ $n = 10$ $Q = 10$
$m = .017$ $S = 12{,}000$ $H = 200$ $l = d^7 - \frac{31{,}260{,}000{,}000}{288.6\ d^2}$

From which the following table is prepared:

d	l	d	l
31.57	0	36	125,900
32	10,490	37	151,100
33	36,150	38	193,300
34	63,720	39	241,300
35	93,570	40	287,000

Two Aids to Better Inspection in Pavement Construction

By C. L. B. Anderson
Lieutenant, C.E.C., U. S. Navy, Norfolk, Va.

THE easier the discharge of the duties of an inspector of engineering construction work can be made, the surer we are of obtaining from him efficient services. For this reason I was interested in the article contributed by Leonard G. Howell in *Engineering News-Record*, Oct. 1, 1925, p. 545. For an inspector on brick pavement construction to lean over and mark each brick which needs replacement due to cracks or softness, or turning on account of kiln marks or chipped edges, is a back breaking job. The device recommended in Mr. Howell's article makes inspection much easier. With such a device many brick will be marked to be turned or removed which would be passed if it were not for the fact that the marking cane makes unnecessary stooping to designate the particular brick.

A similar device is useful in the inspection of the work of laying bituminous pavements. Assuming that the materials used have been found satisfactory, that they are all at the proper temperature and that the mixture has been properly made, it is important to see that the bituminous sheet wearing surface after having been spread and rolled is of the required thickness. For this purpose a cane is used with a stout awl-like metal pin of about the diameter of a ten-penny nail, fastened in the lower end and projecting a distance beyond the end of the cane equal to the required thickness.

That item of paving work which has differed possibly most widely from contract requirements has been the thickness of the concrete base for both brick and bituminous tops. This part of the pavement is constructed rapidly and it is almost impossible to maintain grade

From Job and Office

For Contractor and Engineer

stakes immediately in front of the construction work. It is easy to reduce the thickness of the concrete base by ten to twenty per cent with little evidence of such discrepancy. In the experience of the writer several different schemes have been tried to aid the inspectors in easily determining if the thickness requirements were being observed. The method giving the best results has been described in the specifications as follows:

"The grade and contour (of the concrete foundation) shall be secured by using metal pins and by using wooden cubes having dimensions equal to the thickness of the concrete foundation to be laid. At least three such cubes are to be kept on the subgrade adjacent to the concrete being placed. The contractor is to furnish the above cubes and keep a sufficient supply of the proper size on hand at the site of the work. No laying of concrete foundation will be allowed to begin, or to proceed if begun, unless the required number of cubes are on the subgrade."

A grade stake can be bent over, broken off, or driven down, but not so the wooden cube. In whatever position it may rest it furnishes the inspector a visual comparison between the thickness of the slab actually being constructed and the contract thickness.

There is another, an indirect, advantage in using these cubes. The inspector is responsible for the cubes, to see that they are not concreted into the concrete base, that they are kept in advance of the work, and this responsibility causes the average inspector to give the placing of the concrete better attention. He is unable to center his entire attention on the process of mixing at the expense of the inspection of the actual laying.

Alumina Cement Test Piles Give Foundation Data Quickly

TO AVOID the delay incident to the setting of concrete test piles wherein ordinary portland cement is used, recent experiments with alumina cement have been recorded. Bearing data were thus secured in a fraction of the time that would otherwise have been consumed. One of these uses of alumina test piles was in bridge work in California and the other in building work in Missouri. Harlan D. Miller, bridge engineer of the California Highway Commission, reports one experiment as follows:

In beginning the construction of two bridges near Pismo, Calif., the California Highway Commission wanted prompt information as to conditions that would be encountered in driving piles. Heretofore wood piles have been used for such tests due to the delay that would result from waiting 28 days for an ordinary concrete pile to cure. The tests with wood piles, however, have not been wholly satisfactory because of the difference in the bearing or penetrating power and because wood piles sometimes give a wrong impression and result in casting the concrete piles of an improper length. On this job, therefore, a concrete pile was cast, using alumina cement in place of ordinary portland cement, and 24 hours after the pile was cast it was driven 45 ft. in the ground to refusal.

A steam hammer with a 5,000-lb. ram was used and 643 blows were required to drive the pile to refusal. The pile was 47 ft. long and 18 in. square. So far as could be determined by inspection the pile was not injured in any way by the handling or rough treatment to which it was subjected, except for a little spalling at the top under the blows of the hammer.

It was impossible to get a strength test on the concrete used in the test pile at exactly 24 hr. after casting, but two samples of the concrete tested within 48 hr. after casting could not be broken by the state testing machine which has a maximum capacity of 200,000 lb. This indicated that the strength of the concrete exceeded 5,600 lb. per sq.in., and that after 48 hr. the test pile had a strength at least equal to the usual portland cement pile at the age of three months.

R. W. Cropper, of the Foundation Co. of Kansas City, reports the use of alumina cement in test-pile construction as follows:

The new city hall at St. Joseph, Missouri, is to be a part of a civic center. To fit into the general scheme its location was determined principally by its relation to other buildings.

HEAD OF ALUMINA CEMENT TEST PILE AFTER DRIVING. THIS WAS THE CALIFORNIA TEST

The site finally chosen is on an old filled creek bed. Depth of the fill ranged between 15 and 40 ft. However, as there were no exact data it was decided to dig test pits, and then to sink test piles to secure adequate bearing data. Test piles were driven in sets of three distributed over the site, there being nine piles altogether.

To eliminate the delay in waiting the usual 28 days for portland cement concrete piles to set alumina cement was used. The first set of three was driven before the next set was put in, and so on. By using alumina cement practically 90 days were reduced to nine days, as three days were allowed for setting of the test piles.

The test piles were 14 in. square at the butt and 8 in. at the top. They ranged all the way from 22 ft. to 50 ft. in length. Reinforcing was of ¾-in. round bars and No. 6 wire for spirals. From the results of driving and loading the test piles it was decided to make the foundation piling 40 and 44 ft. long with a 17-in. butt and a 6-in. tip.

The piles withstood exceptionally well the punishment of driving with a steam hammer with a 3,000-lb. ram to a penetration of 13 blows per inch.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Appreciations of Leonard Metcalf

Sir—What can I say of Leonard Metcalf? I might try to tell of his unique position won by long years of untiring work, and made possible by brilliant intellect, by sterling honesty and by a kindly disposition free from the least trace of selfishness. For no one would I do this more gladly. But words fail and I cannot do justice to the subject. To-night, as he lies still, after his long pain, it is a brother that I have lost. For in the years since I lost my own two brothers he has adopted me and has taken me into his own big heart. We have worked and played together; we have lived and traveled together; in the mountains of Colorado and California, in the hills of Massachusetts and Vermont we have shared our most secret thoughts. And in the last year, while he has been living under the cloud of certain early death, we have been working together again on the problems we both have loved so well, with no drop in his mastery and power. May there be more men like him in the years to come!

ALLEN HAZEN.

New York City,
Jan. 31, 1926.

Sir—Perhaps the most marked and the underlying characteristic of Leonard Metcalf was his loyalty and devotion to his family—his mother throughout her life, his two sisters, and more distant relatives. His watchful care of them was ceaseless. His keen interest, also, in the welfare of others, particularly of his professional associates, members of his staff, and students whom he chanced to know, his sympathy and generosity, were recognized by his intimate acquaintances as typical characteristics.

His honesty of thought contributed to the absolute fairness of his decisions and actions. One of his precepts was "face the facts." He strove to discover them and thereafter he builded his structure upon them. This characteristic was especially marked during the last year of his life, when faced by certain death predicted with indisputable accuracy, he continued his professional practice with all the enthusiasm and vigor of former times until actually laid low by the fatal malady. Even after becoming confined to his bed, Mr. Metcalf wrote two valuable papers on rather involved subjects, for the benefit of the profession. He believed in the practice of engineering as a profession and not as a business. His standard of professional ethics was high, and, as would be expected of one of such keen sensibility, his practice accorded with this standard. He abhorred gossip and would rarely repeat even to his closest friends a rumor in the least derogatory of another engineer. He counseled thoroughness, accuracy, refinement of detail and perfection in workmanship. While he was possessed of keen business instinct this was never allowed to dominate. On the contrary Mr. Metcalf insisted that the interests of his clients be protected even if this involved material sacrifice to himself.

Mr. Metcalf enjoyed art, travel and literature. He cultivated refined English of which he became a master. His natural clearness of vision was supplemented and accentuated by an unusual clarity of diction. He was fond of nature and spent much time in the mountains of California and in the Colorado Rockies where he had his summer home.

His brief early experience as a teacher developed and fixed certain natural tendencies. In consequence of this, he never let pass an opportunity to point a lesson from fact, for the benefit of the younger, less experienced engineers. He was deeply interested in educational matters and was very fond and proud of the achievements of Massachusetts Institute of Technology.

His sympathetic interest, enthusiasm and optimism, tempered by sound judgment, were a source of inspiration to all who came in contact with him, particularly the younger engineers. He was an indomitable worker. His keen intellect, quickness of thought and action, and his will to work, resulted in that effective productiveness which distinguished him.

Finally, Leonard Metcalf exemplified in a most unusual degree the qualities of morality, integrity, generosity, fairness, honesty, idealism, energy, perseverance, thoroughness and courage. He inspired the respect, esteem and affection of all who came into close contact with him. Service was his outstanding characteristic—service to his relatives and friends; to his town, state and country; to the profession which he loved, and to his clients.

H. P. EDDY and CHARLES W. SHERMAN.

Boston, Mass.,
Jan. 31, 1926.

Sir—In the passing of Leonard Metcalf, the engineering profession loses one of its most courteous, kindly and dignified personalities who won first rank through his achievements to advance the standing in this country of the engineering profession and particularly of the water-works and valuation groups in which he was one of the foremost practitioners in his engineering generation.

As a water-works engineer, Leonard Metcalf was unusually thorough and painstaking. On a large number of sizeable projects, in various sections of the country, his reports are models for completeness of detail in the application of best procedures, combined with lucid, straightforward summaries for the guidance of those in administrative authority. He knew no other method than that of going thoroughly and with most meticulous care into whatever he undertook. His command of language was most happy and his reports and papers show a clearness of expression worthy of highest commendation. He was a prolific writer and his contributions to engineering literature constitute a valuable addition, recording important advances during his day.

Of the milestones of progress set up during his period of activities perhaps his greatest contribution was that in the field of valuation of water-works and other utilities. He rendered outstanding service some ten years ago as a member and secretary of a committee on valuation of the American Society of Civil Engineers. While this committee did not, and no committee could bring about complete unanimity of views, it did produce a report which led to a much better order of things in that it promoted orderly thinking and advanced current methods of treatment of the subject to a more logical and intelligible position. This is shown by the beneficial influence which that committee report has produced upon the decisions of the courts and regulatory commissions and particularly upon the methods followed by engineers who devote themselves largely to valuation work. The importance of the Metcalf influence upon this branch of engineering will be more thoroughly recognized later than has been the case up to this time.

Leonard Metcalf was a good business man. He had a judicial turn of mind. Frequently he was slow in coming to a conclusion pending his efforts to satisfy himself as to the status of the leading elements of a proposition. But after having once reached a conclusion with which he was satisfied, he was singularly happy in his lucid methods of speech and writing, with which he combined a forceful, fearless attitude in advancing the conclusions which he had reached. These characteristics had much to do with the prominent position which he attained in the economical aspects of engineering, particularly as an adviser in the purchase and sale of utilities and in the securing of appropriate rates of charges by utility companies.

Among the younger engineers perhaps the name of Leonard Metcalf may be longest remembered as joint author of "American Sewerage Practice." While the credit of instituting the plan of procedure for the preparation of these valuable volumes belongs to a considerable degree to Mr. Metcalf, it so happened that during the several years of their preparation he was engaged almost wholly in the West on valuation work so that the credit for these volumes belongs essentially to Mr. Eddy.

In the welfare aspects of engineering his contributions were numerous as he gave himself unstintingly to various endeavors for the improvement of the engineering profession. During the past year, after he had become a sick man, his views and encouragement were most helpful in the preparation of the Manual of American Water Works Prac-

tice. In fact, he was the largest individual contributor to the manuscript for that volume. Outside of the members of the Council on Standardization he was one of the two or three most helpful water-works men in the selection of the material for the Manual and in its editing.

The writer had the good fortune to be associated with Mr. Metcalf on quite a number of important undertakings. On none of them were his characteristics as a man and as an engineer more advantageously portrayed than on a Central Committee in Washington in May and June, 1917, when the Construction Division was organized and the general procedure for camps and camp utilities was formulated and contractors were selected for the construction of the training camps. His wide familiarity with engineers throughout the country and his knowledge of sound administrative procedures contributed under extremely novel and trying circumstances wherein time and the saving of human life meant far more than money cost of the camps in a very substantial way to accomplishments which will some day be more and better appreciated than they have been up to this time. In the face of very difficult circumstances his services at Washington were invaluable.

GEORGE W. FULLER.

Tests of Old Flat-Slab Building Belie Joint Committee Rules

Sir—Recently the writer was called upon to make an inspection and report upon a reinforced-concrete warehouse building which had been condemned by the city building inspector as unsafe for a load of more than 100 to 125 lb. per sq.ft., although the floors were originally designed for a live working load of 250 lb. per sq.ft.

The building was built some thirteen years ago and was constructed during the fall and early winter months. The floors are of the flat-slab type commonly known as the "mushroom" system. There are three floors and a roof. The roof is of timber mill construction, and was added at a later date. The design provided for future additional stories on the building. The column diameters are as follows:

	Interior Columns	Wall Columns
2nd Story	16 in.	16 in.
1st Story	20 in.	18 in.
Basement Story	22 in.	18 in.

The plans called for a 9-in. flare of the column capitals on the interior columns, but the building was constructed with 6 in. flares. No column capitals were called for on the wall columns and none were built. The rough concrete floor slabs were shown 7 in. thick and the cement finish was to be 1 in. thick. There are no depressions or drop panels in the slabs over the columns. The slab reinforcing is the four-way type and consists of twelve ¾-in. plain round rods in each belt. The vertical column rods are bent out into the slab and the belts of slab rods pass over the columns at the top of the slab two ways directly and two ways diagonally. There is no other reinforcing in the slab except where openings require special construction. The interior columns are spaced 16 ft. center to center both ways.

At the writer's suggestion the floors were tested to establish their safe carrying capacity. The test panel was loaded in lifts of 125 lb. per sq.ft. Readings were taken before the load was applied and after each successive load was placed until the load equaled 500 lb. per sq.ft. over the full area of the test panel. The deflection increased uniformly and at 500 lb. per sq.ft. equaled just ¾ in. This load was applied on the first floor which has a clear story height of about 14 ft. 4 in. The load was allowed to remain on the floor for 24 hr. and another reading taken which showed no change in the deflection. The load was then removed and another reading taken which showed the recovery of the slab to be complete.

The second floor was subjected to a similar test but the load was only carried to 350 lb. per sq.ft. as the height of the second story is only 10 ft. 4 in. and it was not possible to place 500 lb. per sq.ft. on the floor without bringing in other materials than were at hand. The deflections were in proportion to the load and corresponded with those for similar loads on the first floor.

This test is interesting for several reasons.

(1) Because it was made on a building which had been in constant use as a warehouse, frequently carrying 300 to 400 lb. per sq. ft. for thirteen years.

(2) Because it indicates, as have numerous other tests, that the theory of flat slabs proposed by the Joint Committee is not correct for all types of flat slab design.

(3) Because it indicates that the building industry is being penalized by building ordinances which make the use of drop panels mandatory for all types of flat slab construction, require excessively large column capitals for light floor loads and require an excessive amount of reinforcing in the slabs.

It is interesting to note:

(1) That by the rules for flat slab design proposed by the Joint Committee, the slab tested has the thickness required for a live-load of only 30 lb. per sq.ft. To carry 250 lb. per sq.ft. live-load would require by the Joint Committee rules a 10½ in. slab.

(2) That the slab tested has the minimum diameter of column capital required by said rules for a live-load of only 70 lb. per sq.ft. The diameter of capital required by the said rules for the same slab thickness would be 68 in.

(3) That the slab tested has sufficient steel according to the said rules for only 50 lb. per sq.ft. live-load. The said rules would require 28⅜-in. bars in direct belts and 22⅜-in. round bars in diagonal belts.

(4) That the slab tested carried a test load of 16½ times as great as the slab thickness provides for according to the said rules; 10 times as great as the steel provides for; and 7 times as great as the diameter of the column capital provides for.

The building tested could not be built today to carry even its own dead-load under many of our city building codes as they exist today. Yet it has given thirteen years of heavy service and at the end of that time behaves perfectly under a test load double the design load.

WALTER H. WHEELER,
Designing and Consulting Engineer,
Minneapolis, Minn., 1112 Metropolitan Life Bldg.
Jan. 22, 1926.

Free Government Engineering

Sir—The editorial on "Free Government Engineering Again," in your issue of Jan. 21, p. 103, is timely. You might have extended it further. There is a markedly increasing tendency in state boards of health to exceed their functions and duties by rendering engineering services, both field and office, accompanied by elaborate reports and cost estimates on water-works and sewerage problems to municipalities within their state free of all cost to the municipality. Of this we have specific knowledge in several cases.

Further, we know of several instances—and there are doubtless many others—in which paid employees of a municipality or a state board of health have actively sought and obtained professional engagements for private work, the approval of the plans for which is required to be passed upon by the department in which they are employed and the approval to their superiors actually made by themselves.

Let us hear through *Engineering News-Record* of some of the experiences of our friends in private practice if they are not afraid of being placed on the black list in recommendations for private engagements.

D. J. HOWELL,
David J. Howell & Son, Engineers.
Washington, D. C.,
Jan. 25, 1926.

New York City Garbage Disposal Methods

Sir—In reporting my discussion of garbage disposal before the Sanitary Engineering Division of the Am. Soc. C. E., p. 157 of *Engineering News-Record*, Jan. 28, nearly 2,000,000 cu.yd. should be stated as the total garbage and refuse production in the Boroughs of Manhattan, Brooklyn and the Bronx in 1925 instead of the amount sent to sea. The correct figures are: Dumped at sea, 1,662,520 cu.yd.; incinerated 293,936 cu.yd. This was disposed of in four incinerators, one of which was completed later in the year. These are under the direction of Alfred A. Taylor, commissioner of street cleaning. The other ten incinerators (one yet under contract) are in the other boroughs.

KENNETH ALLEN,
Sanitary Engineer, Board of Estimate.
New York City,
Jan. 29, 1926.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Large Write-Off Proposed on Reclamation Projects

Board of Adjustment Favors Writing-Off $14,317,150—Places More in Suspense

Reporting on an investigation of 19 reclamation projects, a board of adjustment and survey which has been at work during the past year recommends that the sum of $14,317,150 be written off as a definite loss on these projects, and the cost charged against the landholders correspondingly reduced. It also finds that on the same project an additional sum almost as great, namely, $12,785,137, be placed in suspense account as a probable future loss. These amounts are larger than those tentatively reported by the Fact Finding Commission which studied the reclamation projects two years ago; the report states that this is largely due to the discovery of additional areas of land lacking reasonable productive power. The board was composed of four members representing the Bureau of Reclamation directly, and ten representatives of states or reclamation projects. The full list of recommended write-offs is given below:

Project	Probable Loss	Definite Loss	Total Loss
Belle Fourche..	$734,518	$544,521	$1,279,139
Boise.....	495,369	.....	495,369
Carlsbad.....	45,867	.....	45,867
Grand Valley..	1,344,409	760,628	2,105,037
Huntley.....	719,642	168,981	888,623
King Hill.....	287,024	531,958	818,982
Klamath.....	62,711	170,684	233,395
Lower Yellowstone.....	607,017	382,254	989,271
Milk River....	1,878,656	1,946,189	3,824,845
Minidoka.....	132,787	9,172	141,959
Newlands.....	813,264	4,536,396	5,349,660
North Platte....	2,599,987	237,877	2,837,864
Okanogan.....	99,473	720,700	820,173
Rio Grande....	.....	43,158	43,158
Shoshone.....	534,006	1,715,666	2,249,672
Run River-Fort Shaw.....	131,940	125,531	257,471
Umatilla.....	484,088	1,054,940	1,539,028
Uncompahgre...	1,436,155	1,365,427	2,801,582
Yakima.....	378,124	3,068	381,192
Totals.....	$12,785,137	$14,317,150	$27,102,287

Only an abstract of the report has been made public by the Reclamation Bureau. According to this abstract, the principal reasons for write-offs are inclusion of unproductive land in the project area and "real or fancied errors in the fixing of acre costs." The report adds, however, that the projects generally are in prosperous condition and that there should be fewer difficulties in their future operation than in the past.

In transmitting the report to Congress, Secretary Work of the Department of the Interior states that he cannot approve of some of the recommendations of the Board of Adjustment, as they do not appear to be within the scope of the law providing for the survey, but that these unapproved items are more important as to principles than as to the money involved. Bills designed to carry out the approved recommendations are to be introduced in Congress.

Engineering Fifty Years Ago

From *Engineering News*, February, 1876

THE Interoceanic Canal Commission, after discussing the reports on six different lines, have unanimously recommended the Nicaraguan route for the Isthmus Ship Canal. The length will be 181 miles, and the estimated cost $66,722,147.

Work on Arlington Bridge to Start in March

Award of the contract for the piers and abutments of the Arlington Memorial Bridge at Washington, D. C., to H. P. Converse, of Boston, Mass., is to be recommended to the Bridge Commission by Major Grant, according to an announcement from Washington. Mr. Converse's bid of $1,299,000 was the lowest made. It is expected that the commission will decide upon the award of the contract by Feb. 15 and if it does, work under the contract must start by March 15.

Engineer License Law Being Enforced in Oregon

An active campaign to enforce the Oregon law which requires all practicing engineers to hold state licenses is being made by the State Board of Engineering Examiners. A. B. Carter, secretary of the board, states that at the present time one county engineer and two city engineers are under investigation and will be removed from their positions if they do not comply with the state law referred to. He cited the case of Eugene B. Henry, formerly city engineer of Klamath Falls, Ore., who was forced to resign in November because he had not qualified by obtaining a state license. Mr. Henry's resignation was secured in the face of the backing of strong political interests that strenuously endeavored to retain him in office. C. T. Darley, a registered engineer, has been appointed to the office made vacant by Mr. Henry's resignation.

The penalty attaching for violation of the law is a maximum of six months in prison and a fine of $500. At the last session of the state legislature, a measure was passed empowering the State Board of Engineering Examiners to use the special fund at their disposal, to such extent as is deemed advisable, for the purpose of collecting evidence to be used in prosecuting violations of the law. It is anticipated that this amendment will result in a much more rigid enforcement of the law than has been heretofore accomplished.

Michigan Conference Holds Record Meeting

Establishes Council of Engineering Society Representatives—Lake Level Control Discussed

One of the largest engineering gatherings in the Middle West and one that marks a new era in cooperative endeavor was staged in Detroit, Feb. 4 and 5. More than 813 registrations, all accompanied by a $3 fee, were received at the end of the first day's sessions of the Michigan Engineering Conference, sponsored by the re-organized Michigan Engineering Society, the Detroit Engineering Society, twenty other organizations in the state, ten individual groups from as many cities, and the engineering department of the three educational institutions. The conference had a threefold purpose: (1) To discuss technical subjects of interest to the public as well as engineers; (2) to provide social meetings on a par with the technical sessions, and (3) to develop ways and means of securing greater co-operation among engineers of the state and to provide them with a medium through which they can be heard in national affairs.

Lake Levels Discussed

The question of lake levels discussed exhaustively for 2½ hours by John R. Freeman to 300 men who crowded the all-to-small hall almost to suffocation and the two evening sessions on all phases of present day air transportation, admirably fulfilled the first purpose of the conference. The entertainment left little to be desired and the third purpose was taken care of by the establishment of a council of men chosen from every technical society in the state, whether the society itself subscribed to the conference or not, clearing through the Michigan Engineering Society, but with a minimum of hampering rules, regulations, constitution and by-laws. The purpose of the council is to establish a medium by which the voice of engineers in Michigan may be made articulate in state and national matters in which he has interest. To determine what action is to be take and how any problem affectink the welfare of the engineer is to be handled. This was explained in detail by Clarence L. Hubbell and the essentials put into effect.

Michigan Engineering Society

In a brief morning business session the Michigan Engineering Society, under the chairmanship of C. L. Hubbell, elected its first set of officers, with George H. Fenkell as the president, since untangling itself last fall from the alliance with the American Association of Engineers, readopted its former constitution and by-laws and

reported a surplus of $1,200 in the treasury for society and $7,060 for the *Michigan Engineer*, its official publication.

Mr. Freeman's address, which was illustrated by half a hundred slides, handled practically every phase of the lake-level situation and was the result of his more than a year's study, first as chairman of the lake-level committee of the Board of Review of the Sanitary District of Chicago, and then in being retained to complete the details of the board's report. Mr. Freeman is about to present his final detailed report. In analyzing the causes of lake-level variations, he went into detail on the less-discussed questions of humidity, wind velocity, evaporation and earth tilt. The latter is responsible for 2½ in. of lowering in lower Michigan-Huron during the last 25 years, he stated. Evaporation data, so prolific in the arid and semi-arid west are decidely meagre in the Great Lakes. For better meteorology records and more stations where earth tilt may be studied, Mr. Freeman made a special plea. The novel features of his talk, however, related to his proposed $8,000,000 lake-level regulating work above Niagara Falls for Lake Erie, largely increasing the harbor facilities at Buffalo and making possible the repair of the rapidly wearing notch in the Horseshoe Falls at an estimated cost of $600,000. For Michigan-Huron as for Erie, he stated there were many feasible proposals, but the one he had studied was 13 miles below the outlet of Lake Huron and consisted of four locks and an open 300-ft. fairway, 27 ft. deep, in which would be a velocity of 6.2 ft. per second. On the bottom of the fairway he placed a herringbone series of concrete baffles to throw the ice to the center and tend to keep boats away from the walls.

ESTIMATES OF COST

Both works are estimated to cost less than $35,000,000 and the 2-ft. increased depth is estimated to be worth $12,000,000 annually to shipping, to say nothing of the value of the water to the power interests in the additional pondage.

Francis C. Shenehon stated that at this stage the method was not nearly so vital as to get to work. Several methods were feasible and limits could be determined as more data became available. Gardner S. Williams, congratulated the army engineers in making the obstructions caused by excavations for the Livingstone Channel compensate for the channel deepening.

The conference resolved to urge Congress to pass a recent bill calling for a deepening of all lake channels and harbors to 30 ft. and endorsed the deep waterway to the Atlantic.

Other papers of interest to civil engineers were on "Stream Pollution" by Harrison P. Eddy and "Building Codes" by Frank Burton.

Besides Mr. Fenkell as president, the other officers of the Michigan Engineering Society are as follows: vice-presidents, G. J. Wagner and G. C. Dillman, treasurer, H. L. Hudson, and secretary, H. A. Shuptrine, Detroit.

Engineers and Architects Needed for Government Work

In view of the fact that bills for the extensive public program of the government have been favorably reported to both branches of Congress, the United States Civil Service Commission is looking for approximately 200 engineers and architects for work in the supervising architect's office in the preparation of plans.

Chicago's Calumet Harbor Project Checked

An agreement between the city of Chicago and the New York, Chicago & St. Louis R.R. for dredging and land reclamation to form a harbor in Lake Calumet has been disapproved by the Illinois state authorities on the grounds that the city has exceeded its powers in making certain grants of land, that the cost to the city will be excessive, and that the agreement is not in the interests of the public.

Ontario Hydro to Build Second Plant on Nipigon River

The Ontario provincial government has authorized the Ontario Hydro-electric Power Commission to begin work upon a power development on the Nipigon River, in Northern Ontario, at Alexandria Falls. The new plant will be located about 2½ miles below the commission's 75,000 hp. plant at Cameron Falls. It will have an ultimate capacity of 50,000 hp. and will cost $7,000,000.

A.R.E.A. Nominates Officers

For president in 1926 the American Railway Engineering Association has nominated C. F. W. Felt, chief engineer of the Atchinson, Topeka & Santa Fe Railway System. For one new vice-president there are two nominations: W. D. Faucette, chief engineer of the Seaboard Air Line Ry., and Edwin B. Katte, chief engineer of electric traction, New York Central R.R. The election, which includes directors and members of a nominating committee, will be held at the annual meeting in Chicago, March 9 to 11.

License Issued for Large Power Project on Osage River

The Federal Power Commission has issued a license to Walter Cravens, of Kansas City, for the development of power on the Osage River in Missouri. This power plant is to be built near Bagnell, Mo., by the Misouri Hydro-Electric Power Co. and it is expected that work will be commenced in the near future. Plans call for a dam 2,450 ft. long and 140 ft. high. On account of the character of the stream valley above the site, the reservoir will be 110 miles long, but will have a surface area of only 60,000 acres. The primary power of the site is given as 18,000 hp., but the installation called for in the plans is about 120,000 hp. The estimated cost of the work is $10,600,000.

Contractor Must Make Changes at Detroit Garbage Plant

As a result of a lawsuit brought jointly by the Departments of Conservation and Health of the State of Michigan, a court decree was issued on Jan. 30 enjoining the Detroit Reduction Co. from the further pollution of the Huron River at French Landing, the decree to be effective April 1. The order covers any discharge from the garbage reduction plant that treats the garbage of the city of Detroit that will be detrimental to fish life or injurious to the public health.

The plant, which was rebuilt after a fire in 1916, has been the repeated cause of complaints, particularly as regards the discharge of stick water into the river, the seepage of garbage juices into the river from garbage stored outdoors, and smoke from the burning of rubbish. Until about 1916 the stick water was discharged directly into the river, but since then it has been pumped to ponds across the river, from which is was supposed to percolate away through the ground. The gelatinous material in the liquor has interfered with this percolation and it is reported that the dikes forming the ponds have given away at times, resulting in the discharge of the stick water immediately into the river. Evaporators for treating the stick water were installed a year or more ago, but have never been used.

SIX-DAY HEARING

The court gave a six-day hearing to the case, beginning Dec. 21. Subsequently, the Detroit Reduction Co. agreed to the stipulations of an injunction, handed down on Jan. 30, as already stated. These stipulations prohibit the discharge into the Huron River of stick liquor, garbage juice, or any other manufactured by-prdouct, or the discharge of these liquids into open ponds except for purposes of collection and treatment in the plant—barring temporary storage during plant breakdown. The company is also prohibited from depositing garbage in piles unless treated with creosote or a similar disinfectant; from piling or burying raw garbage or piling any other material produced in the plant near enough to the river so liquids therefrom will seep into the stream; and from burning rags and waste material except in furnaces or incinerators with stacks high enough to carry off the smoke. Cars of garbage standing on railway tracks at the plant during the period from June 1 to Oct. 1 for more than 48 hr. must be covered with tarpaulin.

The company is already at work on the building of a concrete retaining wall to divert the seepage from old accumulations of material to a pump pit from which it will be lifted and added to the stick liquor. It is assumed that the latter, after evaporation, will be added to the tankage.

Edward D. Rich is director of the Bureau of Engineering of the Michigan Department of Health and Howard S. Murphy is deputy in charge of pollution investigations for the Department of Conservation.

WASHINGTON NOTES

ENGINEERS of the Federal Power Commission have concluded their studies of the Current River, in Missouri, and will recommend the issuance of a preliminary permit to the Missouri Hydro-Electric Power Co. They feel that the plan of this company has certain advantages over those of conflicting applicants.

The Missouri Hydro-Electric Power Co. proposes to develop 60,000 hp. at three power houses.

In order to expedite the development of the Current River and other Missouri streams the state authorities have co-operated actively in furnishing engineering data. The state highway department has altered its road program so that the highway will use the dams for crossings, thereby making the development much less expensive.

There also is activity on the upper White River and on the Gasconade River indicating that Missouri soon is to have several hydro-electric developments.

THREE great trunk highways paralleling the Pacific coast, with a system of laterals, are proposed in a bill introduced into Congress by Representative Raker, of California.

The highways are to follow the lines of defense which would be established in case of invasion.

The road to follow the theoretical first line of defense is to be known as the Balboa highway. The road to serve the second line of defense is to be known as the Pacific highway, while the third is to be known as El Camino Sierra, or inner line of defense.

An appropriation of $250,000 is asked for the preparation of plans for this system of roads.

THE appeal of the Live Oak Water Users' Association and others from an adverse decision of the California State courts in a suit against the Railroad Commission of California and the Sutter-Butte Canal Co., was dismissed by the United States Supreme Court, Jan. 4, for lack of jurisdiction, the Court holding that no federal question is involved. The canal company distributes water in the Sacramento Valley for irrigation purposes. The state railroad commission granted it increased rates in 1918 and again in 1922. Water users sued in the state courts, but lost, and appealed. The decision of the state courts stands.

REESTABLISHMENT of the pneumatic tube system between the North and South railroad stations and the general post office at Boston will be possible if Congress approves a supplemental appropriation for that purpose which has been presented by the Director of the Budget. The resumption of the tube service is desired by the Post Office Department to facilitate the handling of mail which now is subject to delay because of street congestion.

Waco Adopts Commission-Manager Form of Government

The commission-manager form of government has been adopted by the city of Waco, Tex., as a result of the recent voting on a proposition to substitute this form of government for the aldermanic plan.

Barge Line to Operate from St. Louis to St. Paul

A contract has been signed between the Inland Waterways Corporation, a government corporation of which Secretary Davis is chairman, and the Upper Mississippi Barge Co., representing the cities of St. Paul and Minneapolis whereby the Inland Waterways Corporation will operate barges on the Mississippi River between St. Louis to the Twin Cities. The Upper Mississippi Barge Co. will furnish the necessary barges and auxiliary crafts which will be operated by the government corporation. Also, it will employ a competent engineer to advise the cities along the upper river concerning terminal facilities. The contract stipulates that Minneapolis and St. Paul will provide the necessary terminal facilities at the upper end of the line.

Hewett to Direct Construction on Mersey Tunnel, England

B. H. M. Hewett, who has been associated with the firm of Jacobs & Davies, consulting engineers, New York, for the past 20 years, has gone to London upon the invitation of the firm of Mott, Hay & Anderson, consulting engineers, to take charge for them of the construction of the Mersey River tunnel to connect Liverpool and Birkenhead. The tunnel, to be built at the narrowest part of the river, is to provide for two lines of traffic, an estimated capacity of 2,000 vehicles an hour. The distance between shore lines at this point is about 3,800 ft., but long approaches will be necessary. The depth of water is 80 ft. and the tidal range reaches a maximum of 30 ft. The ground at this point is a glacial gravel overlying sandstone. The tunnel will have an internal diameter of 44 ft. and will lie at a depth exceeding that at which the pneumatic process of construction may be used. Consequently, the construction of the tunnel, which will be carried through the sandstone, will be preceded by cementation of the sandstone to make it watertight. It is expected that construction will take five years. The preliminary work is now under way.

Mr. Hewett's first engineering work was on the Central London Ry., one of the deep-level shield-driven tubes. Later he was resident engineer on tunneling for the City & South London Ry. His first work in New York was as general resident engineer on the Hudson River tunnels of the Pennsylvania R.R. Later he was on the construction of the Astoria gas tunnel, the Center St. subway loop, the 38th St. (Brooklyn) subway work, and the Laxaxalpam aqueduct tunnels in Mexico. Besides this he has been interested in other tunnel work of the firm of Jacobs & Davies including Moffat tunnel in Colorado.

RANDOM LINES

Position Wanted

Sir:—Should any of your readers need a fine timekeeper I suggest you consider the enclosed application of Mr. Wilfred Bell, the friend of Mr. George Gumbs. E. W. W.

Santo Domingo

Dear Sir:—I undertake upon myself forwarding you my autograph of consulting your honorable attention, hoping they will be observant to your comprehension, as I have heard that you is Administrator of the Public construction of the Engineering works That is conformity to the Government.

So I petition my application to your hospitable gentry for a position as a time keeper, or an assistance helper to your personal servying, hoping it will be acceptable to your behoof.

I respectfully awaits your verification, I beg should my service be require'd you should make known to Mr. George, Gumbs, the Janito of same office, who? knows me personally

Remain most attentively
Wilfred. L. Bell

* * *

Dobbin's Curve

Mr. Rayfield, industrious and courteous, a civil engineer of the old school, assembled his party one bright, crisp morning. The job at hand was staking the center line of a Bridgeport, Connecticut street. The grade of the street was an ascending one of about 3 per cent for several hundred yards, and descending at a sharper angle. The neighborhood was thinly settled, but a brick chimney raised its top above the crest of the hillock, making it an ideal object for a foresight. The transitman set up at station zero, picked his chimney sight and staking began, posts being set at 50-ft. intervals. The driving was hard work. It was necessary to use an iron bar to make a hole for every stake. When about 200 ft. had been run, the transitman moved up to a new hub, since traffic on the cross-street had become annoying. Again he set up and sighted as before and the job proceeded. When another 200 feet or so had been staked it was noticed that stakes were not in line. This information was at once announced, and Mr. Rayfield came forward and verified it.

"What are you doing?" he shouted at the transitman.

"Givin' line and freezin' in th' bargain" replied that individual.

"Givin' a dog-gone curve, dammit" said the head chainman. Meanwhile, the other chainman, urged by a sudden "hunch," had trotted ahead to the top of the hill and was now shouting and beckoning the others to join him. They joined him immediately. They looked ahead.

The house with the convenient chimney was on rollers and a patient old dobbin was toiling at a windlass.

F. E. T.

Hearing at Portland on Proposal to Bridge Columbia River

The scheme for building a toll bridge over the Columbia River between the towns of Rainier, Ore., and Longview, Wash., was argued pro and con in Portland, Jan. 22, before the Port of Portland Commission and the Oregon State Highway Commission.

An application for permit was presented to the War Department early last year and received tentative approval, subject to approval of the specifications for the bridge by the highway commissions of Oregon and Washington. The Washington commission has given its approval. The approval of the Oregon commission, which still has the matter under advisement, would not be valid under the Oregon state law until approval by the Port of Portland Commission had also been given. Hence the recent hearing before representatives of both the Port and the Highway commissions.

The site of the proposed bridge is about 45 miles down the river from the Portland crossing, and the plans provide for a highway bridge with a clearance of 155 ft. above water level. Objections raised at the hearing were that (1) vessels with masts higher than 155 ft. frequent the port of Portland; (2) channel changes that occur from time to time make it impracticable to fix and limit the channel as a bridge would tend to do; and, (3) because of increased navigation hazards and higher insurance costs, the bridge would be detrimental to deep sea shipping business that now comes to Portland.

Proponents argued against these objections, pointed out the great advantage of such a crossing to interchange between cities and towns of the lower Columbia as well as to through traffic and voiced the sentiment that "lower Washington and Oregon cities are not going to be left on a ferry basis unless they come to Portland to get across the river."

New Station Plans for Newark, N. J., Outlined by Railroad

The Pennsylvania Railroad Co., through Thomas W. Hulme, vice-president in charge of real estate, has advised the city of Newark that it has about completed its study of the plans and costs involved in creating the new additional transportation facilities desired by the city of Newark. The estimated expenditure of $12,000,000 is more than twice the amount the railroad company had expected to spend for this purpose. The company states, however, that it is ready to co-operate with the city in bringing about the larger improvements and to prepare a written agreement to be submitted to the city authorities and the board of directors of the railroad company. The company proposes to build additional tracks and to extend its electrified zone from Manhattan Transfer through the city to the southerly section, to build a new passenger station north of Market Street along the proposed boulevard over the canal bed.

T. A. Gillespie, Contractor, Dies

Thomas A. Gillespie, chairman of the board of the T. A. Gillespie Co., contractors, New York City, died January 27 at his home in West Orange, N. J., at the age of 73 years. Mr. Gillespie was born in Pittsburgh, Pa., and spent much of his life there. After graduation from high-school he became a clerk for the Pittsburgh Gas Co., but soon changed to the office of an iron manufacturer and about 1873 set out for himself as a maker of iron bolts; later for some years associated with George Westinghouse in the development of the natural gas industry at Pittsburgh. In 1890 he formed, with his brother, the T. A. & R. G. Gillespie Co. and in 1897 the T. A. Gillespie Co. was incorporated; it had headquarters in Pittsburgh and branches in New York and other cities. Some of the large construction projects which the company handled were United States government dams on the upper Ohio River, the St. Lawrence Power Co.'s dam at Massena, N. Y., the plant of the East Jersey Water Co. at Paterson, N. J.

Mr. Gillespie was chairman of the board of directors of the East Jersey Pipe Co.

Minnesota Engineers, Architects, and Surveyors Meet

The Minnesota Federation of Architectural and Engineering Societies held its fifth annual convention, Feb. 5 and 6 at St. Paul, Minn. E. V. Willard was elected president for the following year with L. C. Moore, 1st vice-president, F. H. Mann, University of Minnesota, 2nd vice-president, E. S. McGowan, Minneapolis, 3rd vice-president, C. Converse, St. Paul, treasurer, and K. A. Feucht, secretary. Mr. Willard is Commissioner of Drainage and Waters for the State of Minnesota.

The program consisted of six papers; Insulation of Buildings, Aerial Mapping, Electric Power Development of Minnesota, Iodine Treatment of Public Water Supplies, Architects and Bridges, and Commercial Arbitration.

The work of the Minnesota federation is done largely by committees, and the work of these committees attracted sufficient attention at this convention to bring out the idea that the federation dispense with technical papers entirely at their conventions and devote the time to reports dealing with national, civic and state affairs.

The Minnesota Surveyors and Engineers Society held its thirty-first annual convention at St. Paul, Minn., Feb. 4-5. By arrangement a meeting of the Minnesota Highway Engineers was held there the day previous and the Minnesota Association of County Commissioners held their annual convention at the same time. The Minnesota Surveyors and Engineers Society elected the following officers: M. E. Chamberlain, Montevideo, Minn., president, B.W. Sewell, Crookston, Minn., vice-president, and W. M. Murphy, Brainerd, Minn., secretary. T. H. Curtis, Fairmont, Minn., was elected representative of the Society on the Minnesota Federation of Architectural and Engineering Societies.

Stream Pollution Discussed at Oregon League Meeting

The prevention of stream pollution in Oregon, and the right to regulate their own affairs without interference of the state legislature, were the main points considered by the second annual meeting of the League of Oregon Cities held at Portland, Ore., Jan. 30, 1926.

Mayors, city attorneys, city engineers, health officers, commissioners and one city manager, representing twenty-five cities of the state, took part in the deliberations.

H. B. Hommon, sanitary engineer of the U. S. public health service talked about river pollution and some of the methods of preventing it. He outlined a series of tests of the water of the Willamette River, which flows through six of the largest cities, to determine just how much of the impurity of the water is chargeable to each municipality, and suggested that each city should so purify its sewage that the river shall not endanger the health of the inhabitants of cities further down the valley.

Dr. Frederick D. Stricker, secretary of the Oregon state board of health called attention to the fact that the river is now nearing its limit as a stream for sewage disposal. He said that an almost certain method of getting typhoid fever is to drink the raw river water at any point below Portland.

Ed. F. Averill, representing the state game commissioner, which has charge of game fish as well as other game, said that the commission was going to insist that the waters of the state be kept pure. He said that the cities would be required to install sewage disposal plants as rapidly as possible so that no untreated sewage would be emptied into the rivers after ten years.

The next meeting of the League is to be held in Salem some time in next November or December.

The secretary of the League is R. R. Shawcross, assistant Commissioner of public works, Portland.

It is expected that the next meeting will formulate a program of desirable legislation for presentation to the legislature which will convene shortly after the meeting.

Wood-Preservers' Meeting

At the 22d annual meeting of the American Wood Preservers' Association, held at Cleveland, Ohio, on Jan. 26 to 28, the proceedings were opened by Mr. Hopkins, city manager, and an address on "Wood Preservation in Relation to Forestry" was given by A. Leopold, assistant director of the U. S. Forest Products Laboratory. There was also an address by C. E. Denney, vice-president and general manager of the New York, Chicago & St. Louis R.R. About a dozen committee reports were either adopted or accepted as information. The new officers include: President, C. F. Ford, supervisor of tie and timber department, Rock Island Lines, Chicago; vice-presidents, O. C. Steinmayer, Canada Creosoting Co., Montreal, and H. R. Condon, assistant forester of the Pennsylvania R.R. It was voted to hold the next meeting at Nashville, Tenn.

Engineering Societies

Calendar

Annual Meetings

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting, Chicago, Ill., Feb. 23-26, 1926.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill.; Annual Meeting, Chicago, March 9-11, 1926.

NATIONAL CONFERENCE ON STREET AND HIGHWAY SAFETY, Washington, D. C.; Second Annual Conference, Washington, D. C., March 23-25, 1926.

CONFERENCE OF STATE SANITARY ENGINEERS, Washington, D. C.; Annual Meeting, Buffalo, N. Y., June 5 and 7, 1926.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Meeting, Buffalo, N. Y., June 7-11, 1926.

The Association of Highway Officials of the North Atlantic States will hold its Second Annual Convention at Syracuse, N. Y., Feb. 17-19, 1926.

The Canadian section, American Water Works Association, will hold its annual meeting at St. Catharines, Ontario, March 3-5, 1926. A. U. Sanderson, Superintendent, Toronto Filtration Plant, is secretary of the section.

The United Engineering Society board of trustees, at its annual meeting held Jan. 28, elected the following officers for the ensuing year: President, W. L. Saunders; 1st vice-president, Bancroft Gherardi; 2nd vice-president, Lewis D. Rights; secretary, Alfred D. Flinn; treasurer, Jacob S. Langthorn; assistant treasurer, Henry A. Lardner.

Personal Notes

FRANK C. SHEPHERD, assistant chief engineer of the Boston & Maine R.R., has been promoted to chief construction engineer of the road.

H. G. WRAY has been appointed city engineer of South Bend, Ind., where he will have charge of a $25,000,000 track elevation program. He has resigned as assistant city engineer of Indianapolis, Ind., which position he had held for three years.

J. E. WHITBECK, for the past six years superintendent of the eastern division, U. S. Air Mail Service, will after Feb. 1, be associated with William E. Arthur & Co., Inc., New York City, a firm specializing in the design and construction of hangars and flying fields. Mr. Whitbeck has designed and supervised the construction of all the air mail hangars from New York to Iowa City and supervised the preparation of the flying fields at these places and the emergency fields between New York and Chicago, as well as the lighting of the airway between these points. ARCHIBALD BLACK, a consulting engineer on airplane design, has become identified with the same firm as an associate engineer on landing field design. He will continue his other practice as well.

ISIDORE S. FALK has been appointed director of surveys of the department of health of Chicago, Ill. Mr. Falk holds degrees of Ph.B. and Ph.D. from Yale University; he has been an assistant instructor in public health at Yale and assistant professor of hygiene and bacteriology at Chicago University.

State Engineering Societies

Meetings of some of the state engineering societies still to be held are as follows:

Connecticut	Feb. 16-17,	New Haven
Wisconsin	Feb. 18-20,	Madison
Indiana	Feb. 18-19,	Indianapolis

GRANT ROSS, Aberdeen, Wash., has been appointed city engineer to replace E. G. HUNT, who served in that capacity for a number of years.

JOHN P. DIETRICH has been appointed engineering assistant to City Manager C. O. Sherrill of Cincinnati, Ohio.

R. O. SAGE, for the past four years assistant engineer of the Kansas City Stock Yards Co., Kansas City, Mo., has been appointed chief engineer to succeed S. M. Bate who is entering the contracting business.

F. C. PAULSON, who was division engineer of the Wyoming division of the Union Pacific R.R. with headquarters at Cheyenne, has been advanced to the position of assistant superintendent of the division, no change in location. W. H. LAWSTON of the Colorado division at Denver goes to Cheyenne filling the vacancy made by Mr. Paulson's advancement.

FREDERICK W. FORD has been appointed city manager of Auburn, Maine, and also superintendent of streets there. Mr. Ford has until this appointment been in charge of public works at Methuen, Mass. He is a graduate of the engineering school of Tufts College, was a bridge inspector for the Southern Division of the Boston & Maine R.R., and in the War served in the 35th Engineers.

WILLIAM J. BACKEE, former assistant general manager of the New York, New Haven & Hartford R.R., has been promoted to engineer in charge of maintenance-of-way.

E. R. BONEY, bridge maintenance officer of and for five years connected with the North Carolina State Highway Commission, has resigned to take charge of the erection of a large plant erected by the Atlantic Creosoting and Wood Preserving Works at Norfolk, Va. His place in the bridge work of the North Carolina highway department will be taken by C. B. TAYLOR who is now connected with the department.

ERNEST STENGER, president of the Denver Tramway Co., has been named president of the Denver Water Board. Mr. Stenger is a graduate civil engineer of the University of Michigan. He acted as receiver for the Denver Tramway Co. and was named president after the reorganization. Previous to that time he was a general superintendent on the Denver & Rio Grande R.R. and superintendent of the Southern Division of the Union Pacific R.R.

ARTHUR RICHARDS, formerly city engineer of Chillicothe, Ohio, has been appointed city planning engineer of Altoona, Pa., where a complete plan will be prepared for zoning and traffic requirements. Mr. Richards spent six years on Panama Canal construction, was for a time in the water bureau of Schenectady, N. Y., and in private consulting practice, and then for four years was bridge engineer in the county engineer's office at Columbus, Ohio.

Obituary

T. R. BARROWS, executive secretary, National Sand & Gravel Association, died of influenza at Atlanta, Ga., Jan. 31. Mr. Barrows, contracted influenza while the association was in session at Atlanta.

CHARLES P. TREAT, railway contractor and one of the promoters of the Nicaragua canal, died Jan. 27 in his home in Palo Alto, Calif., aged 79 years. Mr. Treat built some 1500 miles of railroad in various parts of the United States and some street railways, including that of Trinidad, Colo. He began the construction of the Nicaragua canal, and to aid in that work constructed a railroad across the swamps to Greytown, Nicaragua. He was born in Ohio, graduated at Oberlin College, and served in the Civil War.

FRED RUSH, senior member of the engineering firm of Rush & Everson, Terre Haute, Ind., died recently at his home in that city where he had maintained engineering offices for many years.

JOHANN AUGUST BRINNELL, of Stockholm, Sweden, who attained a wide reputation through his tests of the hardness of metals, known as the Brinnell tests or ball tests, died in Stockholm Nov. 17, 1925, at the age of 76 years. He was also known through his metallographic research.

MARTIN F. METSCHER, contractor and builder, Fremont, Neb., died Jan. 21 aged 63 years. He was born in Germany, came to this country more than thirty years ago.

A. L. STYERS, contractor, Omaha, Neb., died Jan. 25 in Omaha at the age of 74 years. He was born in Marengo, Ill., and had been in contracting in Omaha since 1885.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Westinghouse Achievements for the Year 1925

Developments in Electrical Industry of Interest to Civil Engineers and Contractors

By H. W. Cope
Assistant Director of Engineering
Westinghouse Electric & Mfg. Co.

DEVELOPMENTS were recorded during 1925 in practically all of the equipment manufactured by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., some of decided interest to the civil engineering field and all contributing to the rapid advancement being made in the use and further application of electricity. Even those engaged in the electrical industry cannot fully appreciate or understand the many and tremendous problems that are being solved. It is fitting, therefore, to look backward and briefly enumerate some of the more outstanding achievements.

The strides made during the past year in the design and construction of generating equipment have kept pace with the demands of the rapidly expanding central station industry. Work is well under way on the construction of an 80,000-kw. cross-compound generating unit which is believed to be the largest that has ever been built. Each generator is rated at 40,000 kw., 1,800 r.p.m., and the set will be operated in all respects as a single machine.

During the year the company placed in service its largest horizontal water wheel a.c. generator, a machine with a rating of 28,000 kva., 300 r.p.m., 50 cycles, 11,000 volts.

Transmission Lines — Superpower transmission problems have become increasingly important. Valuable service to operating companies has been rendered by the company's new Klydonograph service. This instrument, when suitably connected to the line, measures the magnitude, direction, steepness of the wave front and polarity of voltage surges. It is the only instrument of this type available. The company has placed at the disposal of its customers several experienced engineers to superintend the installation of this apparatus and to interpret the results.

A development of importance in power house and switchboard practice during the year is the introduction of the sheet steel switchboard which seems destined to largely supersede the present slate and marble panels. These steel panels may be completely assembled at the factory with instruments and other apparatus mounted so that the customer is relieved of the trouble of unpacking and erecting the individual pieces of apparatus.

The remarkable growth in size and capacity of the turbines has been without precedent. Twenty years ago a 1,000-kw. turbine was considered large. Ten years ago a 30,000-kw. turbine was considered remarkable. Last year a 60,000-kw. turbine was considered the practical limit. Today, the 80,000-kw. two-cylinder, cross-compound turbine is nearing completion.

Heavy Traction—In the field of steam railroad electrification, two separate and distinct types of locomotives have been successfully placed in operation. These two locomotives, one representing the largest locomotive of any kind ever placed in service, and the other, a large motor-generator type locomotive, are being utilized respectively on the Virginian Ry. and on the Detroit, Toledo, and Ironton R.R.

The Pennsylvania R.R. has ordered electrical equipment for three switching locomotives, each of which will be equipped with a 500-hp. Diesel engine. Each engine will be direct connected to a generator furnishing power to the traction motors.

In the field of lighter traction, gasoline-electric buses have been placed in service as an experiment and are said to be showing many advantages over other forms of buses.

Dredging Operations—The new 30-in. Diesel-electric dredge Clackmas put into operation last summer by the Port of Portland Commission is not only one of the largest and most powerful suction dredges ever constructed, but is also the first large pipe line dredge to be constructed using the Diesel-electric system for all drives. The main power plant of the Clackamas consists of four McIntosh & Seymour Diesel engines with a total rating of 3,300 hp. direct connected to four Westinghouse d.c. generators having a total rating of 2,300 kw. The four main generators feed into a common bus from which power is distributed to the various operations of the dredge.

The main drives on the Clackmas are main pump, cutter, and swing winch. The main pump is driven by a 2,700-hp., 500-volt, 250 to 360 r.p.m. adjustable speed, compound wound, direct-current motor. This motor is the largest ever built for dredging purposes. The cutter is driven by a 250-hp., 275-volt, 600 r.p.m. shunt wound, d.c. motor. This motor receives its power from a 200-kw. motor-driven generator and is controlled by the Ward-Leonard system.

Fig. 1—Control Room of the Dredge, Clackamas

Illumination—The Bi-lux refractor, as announced last year, for ornamental street lighting purposes has been adopted by over 150 municipalities throughout the country. Now another type of directional refractor, known as the bowl type or pendant Bi-lux has been designed, especially adapted for use in overhead pendant units, a large number of which are used in the outlying sections of our cities. Improvements on the street lighting fixtures have been made with a view toward reducing maintenance costs, an example of which is seen in the dust and insect-proof globes. Over 50 special designs of lighting units have been completed during the year as a result of an increasing demand by civic and municipal authorities for lighting units and standards of original design.

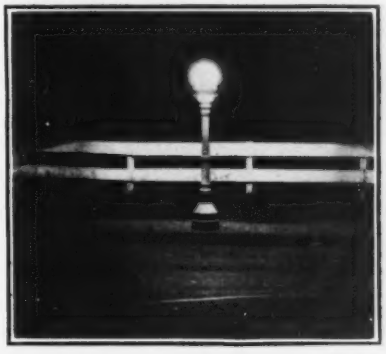


Fig. 2—Traffic Beacon Using Auxiliary Services of Light to Illuminate Surrounding Area

A new traffic warning beacon has been designed which contains an auxiliary source of white light for the illumination of the standard itself in addition to the warning light that is periodically flashed by a mercury contact switch located in the base of the standard. The white light source is not visible to the motorist, although it is capable of illuminating an area of approximately 200 sq.ft. when the beacon is mounted at a height of 6 ft. from the ground. The white light is not flashed, but burns steadily.

Yardages for Concrete Roads in 1925 Increase Over Other Years

The final summation of the table below, the monthly increments of which have been published in these columns during 1925, shows that the total yardage of concrete roads, streets and alleys awarded during 1925 totalled 104,069,341 sq.yd. In 1924, 99,040,427 sq.yd. were awarded while the figure for 1923 was 79,569,387.

For December the square yardages included in concrete pavement contract awards, according to the Portland Cement Association, were: 2,491,273 for roads; 1,580,714 for streets; and 1,171,

817 for alleys; or a total for the month of 5,243,804 sq.yd.

The accompanying table summarizes the statistics for 1925:

SQUARE YARDS OF CONCRETE PAVEMENT AWARDED DURING 1925

Month	Roads	Streets	Alleys	Total All Classes
Jan....	3,474,421	963,256	75,236	4,512,913
Feb....	3,787,192	1,201,224	58,723	5,047,139
March.	5,728,862	2,483,662	190,553	8,403,077
April...	12,462,646	4,431,220	469,117	17,362,983
May...	7,724,075	4,169,707	392,656	12,286,438
June...	5,980,857	3,904,733	335,981	10,221,571
July...	6,361,686	5,147,203	535,156	12,044,045
Aug....	6,368,201	2,973,301	252,341	9,593,843
Sept...	4,087,442	5,018,902	624,006	9,730,350
Oct....	3,710,836	2,163,903	260,642	6,135,381
Nov....	1,717,613	1,626,602	143,582	3,487,797
Dec....	2,491,273	1,580,714	1,171,817	5,243,804
Totals	63,895,104	35,664,427	4,509,910	104,069,341

"Lone Star" to Be Brand Name of Cement

Effective Jan. 1, 1926 "Lone Star" became the brand name under which the product of all subsidiaries of the International Cement Corporation in the United States is marketed. While selling their product under one brand name the various International subsidiaries, it is stated, maintain undiminished their strictly local character. About 96 per cent of the cement produced by International is sold through building-material dealers. The International system consists of ten allied companies operating ten mills having a combined capacity of 12,000 bbl. annually.

Business Notes

UNIVERSAL PORTLAND CEMENT CO., Chicago, has just bought a tract of land in Cleveland upon which it intends to build a modern cement plant with capacity of 1½ million barrels annually. The land is located on the Cuyahoga River in the heart of the industrial section. Limestone, will be transported from Rogers City, Mich., by boat while other material required for manufacturing will be procured locally.

Plans for the new plant have already been drawn and it is expected construction will start in the near future. The Universal company now has plants at Chicago, Pittsburgh and Duluth, with an annual capacity of over 16,500,000 barrels.

MICHIGAN STATE ADMINISTRATIVE BOARD has authorized the purchase of the state operative cement plant at Chelsea, Mich. Under the terms of an option secured when the plant was taken over, the state has been renting it for two years at $75,000 a year with a privilege of buying for $500,000. The $150,000 paid in rent will apply on the purchase price.

STOCKADE BUILDING SYSTEM, INC., New York City, announces that companies for manufacturing its blocks made from shredded fibers of palmetto, sea grass, or similar material, chemically treated and densely packed have been formed in New York, New Jersey, Tampa, and Baltimore. This product was made public last May. The company states that there are now in hand orders for 20,000,000 blocks.

The DORR CO., New York City, announces that its sanitary engineering sales division is now being managed by Frank Bachmann, with E. B. Besselievre as assistant manager.

EISEMANN MAGNETO CORP., New York City, announces changes in its field staff. Irving W. Edwards, for the past year Pacific Coast representative, has been transferred to Detroit, succeeding E. H. Hohenthal, resigned as district manager. O. L. Bachman who has acted as traveling service representative in the Detroit territory since 1919, becomes district manager on the Pacific Coast with headquarters at San Francisco. R. E. Dinnsen has been appointed assistant manager of the Chicago branch succeeding C. M. Montz, resigned.

DEXTER PORTLAND CEMENT CO., of Pennsylvania, it is reported, will acquire the business and assets of the Penn-Allen Portland Cement Co. The enlarged company will have an annual capacity of 2,350,000 bbl. The Dexter plant is near Nazareth, Pa., where the company owns 360 acres of land, about 200 of which are underlaid with suitable stone. The mill has an annual capacity of 1,275,000 bbl. The Penn-Allen properties, embracing about 250 acres, of which one-third are underlaid with cement rock and immediately adjoining the Dexter properties, have an annual capacity of 1,075,000 bbl.

NORWOOD-NOONAN CO., Chicago, are moving to 440 West Superior St. where they have trebled their floor space to take care of their increased business in furnishing such accessories for bridge operation and control as gasoline engine units, electric crossing gates, control benches, limit switches, foot switches, and bridge and pier lamps.

MICHIGAN VIBROLITHIC, INC., announces the addition of O. C. Hubbard to its personnel as vice-president and manager of the company. Mr. Hubbard for 12 years was with the service department of the Universal Portland Cement Co., operating in Illinois and Wisconsin. In 1919 he organized the Wisconsin Mineral Aggregate Association, and was active as its secretary until July, 1922. He then accepted a position as sales manager of the Janesville Sand & Gravel Co., Janesville, Wis. Mr. Hubbard's offices will be in the Kresge Building, Detroit, Mich.

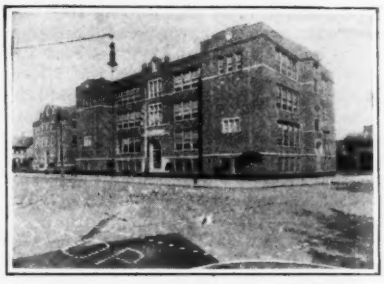
HERCULES MOTORS CORP., Canton, Ohio, announces that its large expansion program includes an additional building at the present plant. Construction will begin immediately and the new building will contain 14,000 sq.ft. of floor space.

CLIMAX ENGINEERING CO., Clinton, Iowa, announces the appointment of F. M. O'Laughlin as sales representative for their eastern sales territory. Mr. O'Laughlin will make his headquarters at 30 East 42nd Street, New York City. George A. Colley, who has previously represented the Climax Engineering Co., has associated himself with the A. G. Griese Co., New York City.

Equipment and Materials

Permanent Marking of Roads and Streets by Brass "Spots"

Traffic control information and guide lines may be permanently built into the pavement by the use of the new traffic spots manufactured by the Bridgeport Brass Co., Bridgeport, Conn. These traffic spots are brass cups made in two diameters: 3 in. for pedestrian lanes and markings and 4½ in. for traffic divisional lines. It is claimed that they are permanent, noncorrosive, highly visible, easily inserted and require no up-keep. They are



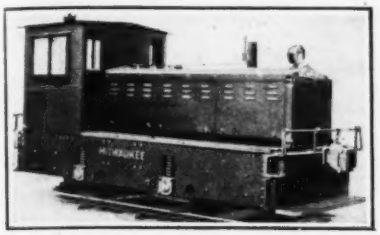
adaptable to asphalt, macadam, wood block, and new concrete pavements. The insertion in the pavement is accomplished by pounding with a flat-faced cast-iron road tamper. Another good method which is considerably faster is to lay down the spots where marked and run a steam roller over them. They can, of course, only be placed in concrete pavement at the time it is constructed.

The best results are said to be obtained by inserting one 3-in. spot in every foot; that is, leaving 9 in. between the inner edges of the spots. The larger or 4½-in. spots can be placed 16½ in. on centers. Such spacings are recommended for lines; when laying out words or arrows the spacing depends upon the size of the marking. It is claimed that the markers remain unusually bright and show up at night under the rays of headlights just as well as they do in the daytime.

Two New Gasoline Locomotives of 18 and 20-Ton Capacities

The latest addition to the line of gasoline locomotives manufactured by the Milwaukee Locomotive Mfg. Co. consists of two locomotives of 18 and 20 tons capacity respectively. These machines are of the four-speed gear and chain drive type, and are geared for four speeds of 2, 4, 6 and 12 m.p.h. both forward and reverse. The machines are built for all gages of track from 30 to 56½ in. and the design of the frame is such that the center of gravity is exceedingly low, tending to steady the locomotives on poorly surfaced track.

It is claimed that the design of the transmission eliminates all possibility of stripping the gears, and as the gears are always in mesh there can be no clashing. All the gears have exceed-

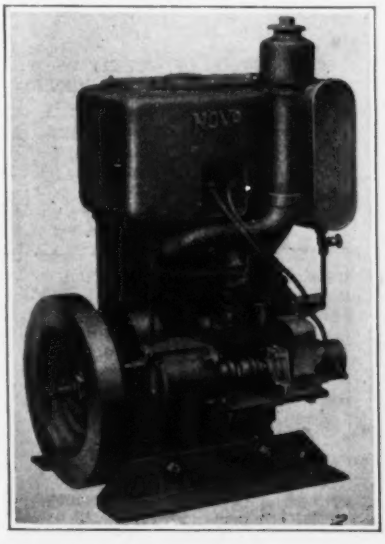


ingly wide faces and are made of chrome nickel steel forgings, except the final driving gear and pinion which are made of steel castings. The removal of the various covers and housings for inspection of the gears and the entire dismantling of the transmission without removing the case proper from the locomotive are features of the design. The driving sprockets on the final drive shaft in the transmission are centrally located between two bearings, thus providing a very rigid and sturdy construction and eliminating the use of a separate jack shaft. Chrome vanadium roller chains are employed for power transmission.

The locomotive is equipped with hand-operated four-wheel brakes as standard but also can be equipped with straight or automatic air brakes when specified. A 12-volt electric lighting and starting system consisting of a generator starter and Westinghouse storage battery is used. The engine is a Beaver six-cylinder heavy-duty type, having overhead valves, forced feed oiling and a maximum speed regulating governor.

New Gasoline Engine Completes Line of 3 to 40 Hp. Engines

The new power unit manufactured by the Novo Engine Co., Lansing, Mich., develops from 3 to 6 hp. It gives the company a complete line of multi-cylinder industrial gasoline engines in ratings from 3 hp. up to 40 hp.



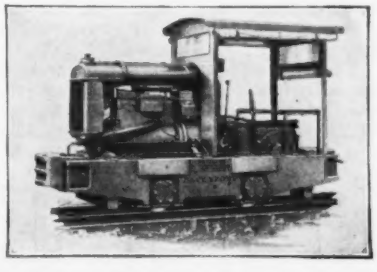
The new engine is a two-cylinder, four cycle "L" head, hopper or radiator cooled gasoline unit. It has an independent drive shaft that can be placed on either the right or the left side of the engine, looking at the engine from the flywheel end. This drive shaft can be furnished to rotate in either direction and at several different speeds. In all cases the governor, carburetor, manifold and magneto side of the engine is away from the drive shaft side. In other words, the working parts of the engine are always accessible, the concrete mixer or whatever machine the engine is operating being on the opposite side. Crankshaft and power drive shaft run in roller bearings.

It is claimed that vibration has been controlled by the use of a 180 deg. crankshaft. It runs at 1,200 r.p.m. The engine can be furnished to run the power drive shaft, which is connected to the crankshaft by gearing, at 400, 600, 1,200 and 1,800 r.p.m. The 400 r.p.m. gear combination rotates the drive shaft anti-clockwise. The 600 and 1,200 r.p.m. gear combinations may be had in either direction of rotation, while the 1,800 r.p.m. gear combination rotates the drive shaft clockwise.

Standard equipment consists of a Splitdorf high tension magneto and Zenith carburetor. The engine is furnished either with or without steel house.

Four-Ton Locomotive Uses Fordson Power Plant

The new 4-ton gasoline locomotive manufactured by the Davenport Locomotive Works, Davenport, Iowa, incorporates the Fordson engine and a

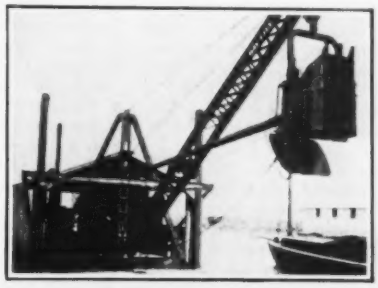


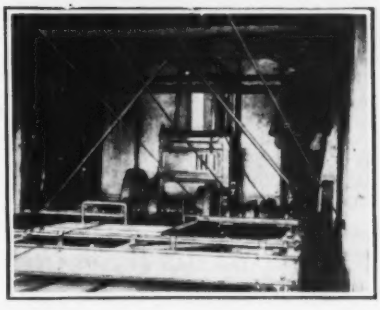
special transmission for its power plant. The transmission provides three speeds forward and three reverse. Fordson engine and transmission parts are used throughout, however, so that easy replacement and repairs are facilitated.

It is said that the design of the locomotive has followed that used in the larger Davenport machines. It is flexible, allowing for the use of a canopy cab, a fully inclosed steel cab or the removal of the cab altogether. The operating levers are placed within easy reach at the right hand side of the cab and clear vision is provided in all directions. The locomotive has a speed range of 3 to 14 m.p.h. at a maximum tractive effort of 2,125 lb. The locomotive starts on gasoline and runs on kerosene. It is said that this 4-ton locomotive completes the Davenport line of 4 to 20-ton gasoline locomotives.

Small Floating Dredge Made from Crawler Mounted Excavator

The one-man excavator manufactured by the Bay City Dredge Works, Bay City, Mich., which is ordinarily furnished with crawler mountings, has in several cases been altered by that company for use in floating service. Several

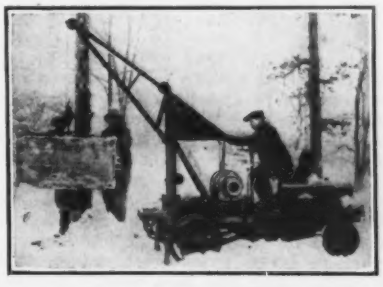




of these machines are now in use by fish and gun clubs in the vicinity of Port Clinton, Ohio. These organizations have a number of acres of marshland along the shore of Lake Erie which are used for duck hunting purposes. The greater part of the year this land is entirely under water and the dredges are being used to excavate small canals, which can be traveled by duck boats. These canals are dug about 3 ft. deep and 12 ft. wide and thus require only a relatively small amount of work. One of the illustrations shows an exterior view of this floating equipment and the other an interior view of the cabin, power unit, and machinery arrangement of the machine.

Tractor-Mounted Hoist and Derrick for Use in Light Work

A machine similar to the one illustrated is being used by the Consolidated Telephone & Electric Subway Co. of New York City for performing some of its light hoisting operations. The basic machine is a Clark truck-tractor manufactured by the Clark Tructractor



Co., Lansing, Mich., upon which is mounted a model "DS" hoist and crane manufactured by the Silent Hoist Co., Brooklyn, N. Y.

One of these machines is being used at the present time for hoisting excavated material from manhole building operations under Madison Avenue, New York City. A major part of the width of the street is decked over and the hoist erected on a staging platform at the curb line. A small skip bucket is used to hoist the material from the excavation; this material is chuted into motor trucks in the street. Spud jacks as shown in the illustration are used to hold the machine in place and remove the weight from the springs. The hoist is chain operated from a countershaft which is also chain-connected to the main shaft of the tractor motor.

The crane is constructed entirely of steel. It is operated by a standard friction clutch power winch used for handling the load and a hand operated winch for raising and lowering the boom, which can be swung the full 180 deg. A 9-ft. boom is usually supplied, but standard cranes with longer booms up to 15 ft. in length are available. The capacity of the crane is 3,000 lb. at 6 ft. and 2,000 lb. at 9-ft. radius.

Publications from the Construction Industry

Snow Removal—CATERPILLAR TRACTOR CO., San Leandro, Calif., has just issued a 50-page publication entitled "The Snow Removal Book." The booklet represents an economic study encompassing the reasons for, the cost, and the methods of financing snow removal. Special problems in the Western states are considered and methods of drift control described. The methods and organization for snow removal in various cities are mentioned, and finally, descriptions and illustrations of equipment for snow removal are given.

Gasoline Engines — CLIMAX ENGINEERING CO., Clinton, Iowa, has just issued a series of bulletins covering the various models of engines which it manufactures. These bulletins give full specifications and information concerning the equipment which is further described by halftones and line drawings. The bulletins describe the bare engines which are also sold made up as power plants, either portable or stationary. This series of engines develops power ranging from 35 to 130 hp.

Structural Waterproofing — CONTRACT WATERPROOFING CO., St. Louis, Mo., has just issued a 75-page handbook on structural waterproofing described as an edition for architects and contractors. The first few pages are devoted to general notes on waterproofing procedure and a description of the company's material known as Ferro-Tite. Data are given on the application of this waterproofing to walls and floors. The major part of the book is devoted to illustrations of buildings in various large cities upon which this waterproofing has been used.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

This Week's Contracts—Week Ago—Same Week Last Year

THE money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks. Minimum costs observed are: $15,000 for water-works and excavations; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial buildings.

Money Value of Contracts Let—Entire U. S.

Week Ending	Public Work	Private Work	Total Contracts
February 11, 1926	$13,382,000	$19,342,000	$32,724,000
February 4, 1926	15,437,000	37,989,000	53,426,000
February 12, 1925	12,524,000	25,268,000	37,792,000
Heaviest Week			
1926, Jan. 21	22,012,000	39,472,000	61,484,000
1925, Sept. 3	16,215,000	69,424,000	85,639,000
January 1 to date			
1926	93,640,000	183,157,000	276,797,000
1925	84,539,000	158,065,000	242,604,000

Wage Trend Upward In German Industries—Building Trades Highest

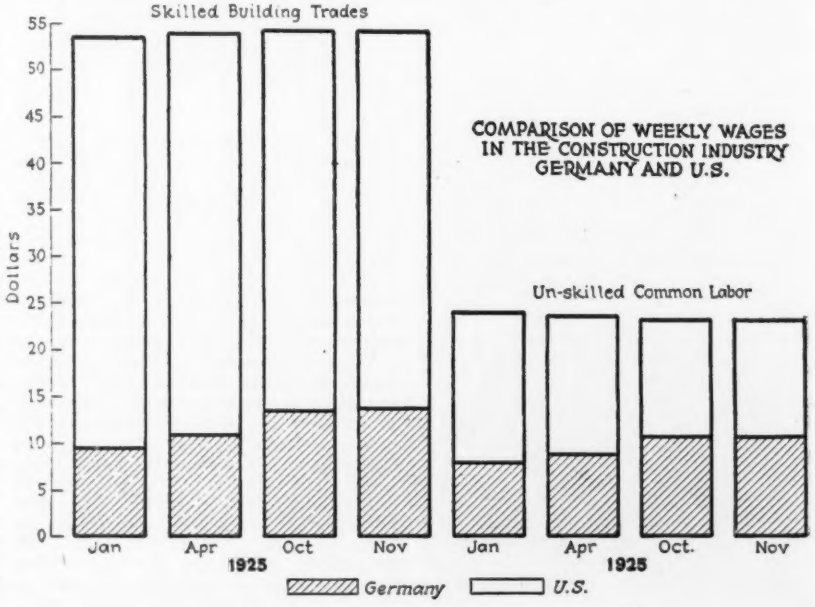
Skilled Construction Labor Costs Rising in Germany and U. S.—Common Labor Rate Tending Downward Here

WITH the possible exception of the wood-working industries, wages in Germany are decidedly on the uptrend, according to reports received by *Engineering News-Record*.

The rise affects unskilled as well as specially trained workers and in the case of the former represents a gain of 21 per cent in eleven months, with an increase of 25 per cent for skilled labor during the same period.

In Germany, as in the United States, the building trades command the highest rates in the eleven industries under consideration. This includes the prinpal branches of the producing and consuming industries, and transportation.

In the construction industry, particu-



larly, the rise in wages of skilled German craftsmen is more sharply upward than that of American building trades mechanics.

The wage rate of common laborers (pick-and-shovel or clean-up men) in construction operations is tending gradually downward in the United States. The gain in the German unskilled rate, however, shows the same abruptness as that of the skilled building trades.

The skilled building worker in Germany gets about $2.43 per week more than the unskilled man. In the United States the average weekly wage of the skilled mechanic is, in most cases, about $30.36 greater than that of the common building laborer.

Rates in the wage tables are expressed in reichsmarks while the chart on p. 262 is in dollars. Trading in the former began Nov. 7, 1924 and throughout the year 1925 the reichsmark did not vary more than 0.05c. from its par value of 23.83c.

AVERAGE WEEKLY WAGES IN VARIOUS GERMAN INDUSTRIES—RATES ARE IN REICHSMARKS AND MERELY SHOW TRENDS

	Skilled, 1925				Unskilled, 1925			
	Jan.	Apr.	Oct.	Nov.	Jan.	Apr.	Oct.	Nov.
Production industries:								
Mining	43.4	44.2	46.0	49.0	31.6	31.9	32.8	34.3
Metallurgical	35.5	40.8	46.2	46.2	25.0	27.8	30.6	31.2
Chemical	34.1	36.7	40.5	40.7	29.3	31.3	34.2	34.4
Building trades	41.2	46.4	55.3	55.4	34.7	38.9	45.2	45.2
Woodworking	37.1	39.8	46.6	46.2	30.7	34.8	40.6	40.6
Paper	26.4	29.1	32.5	32.6	24.0	26.4	29.3	29.3
Consuming industries:								
Textile — Male help	26.9	27.5	29.9	30.1	21.6	22.8	25.0	25.1
Textile — Female help	19.2	21.7	24.0	24.1	15.4	16.9	18.6	18.6
Confectionery	....	37.4	41.0	46.3	....	32.5	35.4	35.7
Printing	38.4	40.3	46.1	46.1	33.5	35.1	40.2	40.2
Paper box manufacturing — Male help	...	....	38.4	38.5	....	....	32.6	32.6
Paper box manufacturing — Female help	....	....	25.3	25.5	....	....	20.9	21.0
Transportation:								
Government railway	36.2	40.6	43.1	43.2	28.0	32.2	33.3	33.3

Reichsmark: Par value 23.83c.; 1925 high, 23.82c.; low, 23.78c.

TREND OF AVERAGE WEEKLY WAGES IN ALL GERMAN INDUSTRIES

1925	Skilled, Reichsmarks	Unskilled, Reichsmarks
January	36.8	28.0
February	38.8	29.3
March	39.8	30.0
April	40.9	30.8
May	41.8	31.3
June	42.5	31.9
July	43.6	32.4
August	44.1	32.9
September	44.8	33.1
October	45.0	33.2
November	46.0	33.9

New York Subway Awards Total $82,729,373 For Year

Nearest Approach to This Record Was $53,000,000 Let in 1914—Costs About 129 Per Cent Above Pre-War Levels

UP TO the last week in December, 1925, the Board of Transportation had awarded and the Board of Estimate, approved a total of $73,198,169.50 in contracts for the construction of the City's new subway line.

In addition to these contracts for construction of the new system, the board has also awarded three contracts amounting to $9,531,204 for the construction of the extension to the Fourteenth Street-Eastern B. M. T. subway in Brooklyn, making the total awards for the year $82,729,373. The report of the Board of Transportation, in part, follows:

"Never before has anything like this amount of money been awarded for rapid transit construction purposes in a single year. The nearest approach to this record was in 1914, when $53,000,000 was awarded for the construction of part of the existing subways.

"It costs about 129 per cent more to build a subway today than it did at the time the existing rapid transit lines were contracted for, before the World War.

"The average quantities of materials specified in each subway contract are: Earth excavation, 108,000 cu.yd.; rock excavation, 112,000 cu.yd.; concrete, 30,000 cu.yd.; steel, 4,200 tons; tunnel ducts, 152,000 duct ft.; road asphalt, 12,000 sq.yd.; cast-iron pipe, 50 tons; steel rods, 220 tons; three-ply waterproofing, 20,000 sq.yd.; brick in asphalt mastic, 1,000 cu.yd.; vitrified sewer pipe, 250 lin.ft.; steel gratings for ventilators, 4,500 sq.ft.

"These items represent in cost 85 per cent of the total materials used in construction of the eighteen sections of the Washington Heights route.

"The items for rock and earth excavation which are the largest in each contract, include not alone the actual work of excavating, but also that of carting the excavated materials to scows for deep sea dumping or to the shore of the Hudson River for filling and grading the new bulkhead line for park and recreation purposes from 72nd St. to 200th St. These two items also include the backfilling after the structure is built; timbering and decking; pumping and maintenance; protection and restoration of sub-surface structures, such as sewers, gas, steam and water mains and electric conduits or ducts.

"Another factor of increased cost today which was not a factor at the time the existing subways were constructed is the sub-surface congestion due mainly to the presence of other underground lines. If the problem of construction today were the same as in the days when the first subway was built, the location, design and construction now would be far simpler and many millions of dollars could be saved. The intensive use of city streets, particularly in the congested traffic areas, with respect to its effect on present-day subway building, is another consideration which adds to the price of the general contract.

"In New York City today there are some places where five levels of transit exist, including elevated, surface-car and subway lines. These conditions require that the City's new subway be carried to greater depths than were ever anticipated when subways were first built. These conditions not only increase the quantities of excavation necessary and add to the weight of the steel required but also make more difficult and expensive the task of underpinning hundreds of buildings and often forces the work down to water bearing levels, requiring compressed air.

"On the other hand, the advent of the electric crane and the electric shovel, has brought about a more convenient and economical method of subsurface excavation, when compared with coal burning cranes and shovels which made such work very costly. Moreover, when the existing subway lines were built, the motor truck of heavy capacity had not been developed to handle tonnage carried today. Therefore, vertical shafts for excavating by means of buckets attached to derricks are now being replaced by ramps, at steep grades, which can be negotiated by the present-day type of motor truck both for taking away excavated material and bringing steel, cement, sand, terra cotta, brick, etc., to the work.

"Computed on the basis of total quantities of materials enumerated in the specifications for the eighteen sections of the Washington Heights route contracted for during the present year, a comparison of average prices prevailing today for the principal items and the average prices for materials required in the construction of the subways ten years ago, shows the following:

Materials	Quantities	Unit Cost 1925	Unit Cost 1915–1916	Per Cent Increase
Earth excavation	1,944,000 cu.yd.	$9.73	$4.04	140
Rock excavation	2,016,000 cu.yd.	11.57	5.61	106
Concrete	540,000 cu.yd.	21.20	8.93	137
Steel	75,600 tons	121.67	71.44	70
Tunnel ducts	2,736,000 ft.	.29	.12	141
Road asphalt	216,000 sq.yd.	5.06	2.63	93
Cast pipe	900 tons	148.68	46.00	223
Steel rods	3,960 tons	112.64	61.25	84
Waterproofing	360,000 sq.yd.	3.03	1.06	186
Brick and mastic	18,000 cu.yd.	49.28	26.10	89
Clay pipe	4,500 ft.	6.85	2.98	129
Steel gratings	81,000 sq.ft.	4.23	1.71	147

Production Increases at American Shipyards

On January 1, 1926, American Shipyards were building or were under contract to build for private shipowners, 186 steel vessels of 219,793 gross tons compared with 102 steel vessels of 176,933 gross tons on Dec. 1, 1925, according to the Bureau of Navigation, Department of Commerce.

There were 36 wood vessels of 11,756 gross tons building or under contract for private shipowners during the same period compared with 25 wood vessels of 8,736 gross tons on Dec. 1, 1925.

Weekly Construction Market

IN CONTRAST with the present downward trend in prices of general commodities, basic building materials appear to be holding firmly to current quotations with even a show of firmness in such items as c.-i. pipe and aggregates. A check to the abrupt decline in the linseed oil market is beginning to appear in parts of the West. New York, Chicago and Atlanta, however, still report decreases.

Taking prices of fourteen basic construction materials in eight of the largest industrial centers of the country, a comparison with one year ago shows a great excess of declines over advances.

Wages of skilled building trades mechanics for the entire country, however, are over 3 per cent higher than in Febuary, 1925. The average common laborers' rate for the nation is exactly the same as a year ago.

Lime, lumber and steel pipe (at warehouse) are higher than a year ago; declines appear in steel shapes (at mill), bars, rivets, c.-i. pipe, cement, gravel, sand, crushed stone, hollow tile, and linseed oil. The advances in the price of brick at New York and Seattle are met by commensurate declines in Minneapolis and Dallas.

Wage disputes are pending in only five of twenty great industrial centers of the country. One of the most important of these is the threatened strike of New York stone masons scheduled for March 1. A similar move for higher wages has not yet been made by other building trades unions in the city.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb.	$3.34	$3.40	$4.15	$3.10	$3.35	$3.07½	$3.30	3.35	$3.75
Structural rivets, 100 lb.	4.50	3.50	4.75	3.50	3.75	4.65	5.00	3.75	5.50
Reinforcing bars, ¾ in. up, 100 lb.	3.24	3.30	3.38	3.00	3.25	3.77½	3.10	3.25	2.30
Steel pipe, black, 2½ to 6 in. lap, discount	48%	—53%	53.6%	51%	54.25%	36%	39.2@51%	45%	59.49
Cast-iron pipe, 6 in. and over, ton	50.60@52.60	+45.30	54.00	50.20@51.20	53.00	64.00	51.00	55.00	55.00
Concreting Material									
Cement without bags, bbl.	2.50@2.70	2.30	2.05	2.10	2.32	2.84	2.31	2.65	1.80
Gravel, ¾ in., cu.yd	1.75	1.90	2.38	2.00@2.20	1.65	1.90	2.15	1.50	1.25
Sand, cu.yd.	1.00	1.50	2.00	2.25	1.25	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.85	+2.50	2.83	2.00@2.20	1.75	2.50	2.15	3.00	1.50
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	62.00	34.00	56.00	57.50	37.75	49.50	27.00	25.00	60.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl	2.25@2.75	1.50	1.85	2.25	1.35	2.70	1.60	2.80	10.00
Common brick, delivered, 1,000	20.40	10.50	11.10	12.00	13.50	12.00	15.50	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	.0977	.10	.075	.....	.075	.....	.10	12
Hollow partition tile 4x12x12, per block	.1112	.0977	.10	.075	.07	.075	.108	.10	.10
Linseed oil, raw, 5 bbl. lots, gal.	—.88½	—.96	1.13	—.88	.99¾	+1.14	1.02	1.12	1.14
Common Labor									
Common labor, union, hour	.62½@.75	.30	.....	87½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	82½	.45@.55	.35@.50	.50	.50	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net and hydrated lime, f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93⅞c.; building laborers, 75c.; excavating laborers, 62½c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone delivered on job; pine is 4-in. instead of 3-in.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.60 for Sheboygan. Common labor not organized.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of February 4, the next on March 4.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5⅓ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Stone and tile are delivered; sand, gravel, lime and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.62). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3½-in., $59.49.

Business Briefs

Call money quoted at 5 per cent, Feb. 8; year ago, 4½ per cent.

Time loans: sixty-ninety days, 4½@4⅝; four-six months, 4⅝@4¾ per cent.

Commercial paper: best names, 4¼ per cent; other names, 4¾ per cent.

On February 1, 1926

E. N.-R. Construction Cost Index Number 206.55

E. N.-R. Construction Volume Index Number 198

For Explanation and Details of Indexes Since 1913 See the First Issue of Every Month